ONTARIO AGRICULTURE AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

2001 ANNUAL REPORT

TO

ONTARIO AGRICULTURAL SERVICES
COORDINATING COMMITTEE

JANUARY 2002

TABLE OF CONTENTS

ONTARIO AGRICULTURE AND FOOD ENGINEERING RESEARCH & SERVICES COMMITTEE

1.0 EXECUTIVE SUMMARY 5
    1.1 Crops Engineering 5
    1.2 Food Engineering 6
    1.3 Livestock Engineering 6
    1.4 Rural Environment Engineering 6
2.0 INDUSTRY / SECTOR SCAN 7
    2.1 Crops Engineering 7
    2.1.1 Major accomplishments since last report 7
    2.1.2 Current state of the industry 7
    2.1.3 Emerging issues 8
    2.2 Food Engineering 8
    2.2.1 Major accomplishments since last report 8
    2.2.2 Current state of the industry 9
    2.2.3 Emerging Issues 10
    2.3 Livestock Engineering 11
    2.3.1 Major accomplishments since last report 11
    2.3.2 Current state of the industry 12
    2.3.3 Emerging Issues 13
    2.4 Rural Environment Engineering 13
    2.4.1 Major accomplishments since last report 13
    2.4.2 Current state of the industry 14
    2.4.3 Emerging Issues 14
3.0 REPORT OF ACTION TAKEN SINCE LAST ANNUAL REPORT 15
4.0 ISSUES 16
5.0 RECOMMENDATIONS ARISING FROM THE IDENTIFIED ISSUES 16
    5.1 Crops Engineering 16
    5.2 Food Engineering 16
    5.3 Livestock Engineering 17
    5.4 Rural Environment Engineering 18
    5.5 Detailed Recommendations 19
6.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS 32
    6.1 Crops Engineering 32

6.2 Food Engineering 33
6.3 Livestock Engineering 35
6.4 Rural Environment Engineering 35
Appendix 1 – Membership Lists 37
Appendix II : Subcommittee Reports 42

CROPS ENGINEERING

TABLE OF CONTENTS 44
LIST OF ACRONYMS 45
1.0 EXECUTIVE SUMMARY 46
2.0 INTRODUCTION 47
3.0 SUBCOMMITTEE ACTIVITIES 47
4.0 STATE OF THE INDUSTRY 47
5.0 ACHIEVEMENTS 48
6.0 EMERGING ISSUES 50
7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS 51
7.1 Summary Of Distribution Of Recommendations 51
APPENDIX 59
10.1 2001 List Of Crops Engineering Research And Services Needs: ... .60
10.1 Complete List Of Research And Services Needs In A Priority Listing 65
10.2 Memorandum To: Subcommittee Of The O.A.E.R.S.C. 66
10.3 Crops Engineering Committee Membership 2002 67

FOOD ENGINEERING SUBCOMMITTEE

TABLE OF CONTENTS 69
LIST OF ACRONYMS 70
1.0 EXECUTIVE SUMMARY 71
2.0 INTRODUCTION 72
3.0 MISSION or MANDATE 72
4.0 INDUSTRY/SECTOR SCAN 72
4.1 Major accomplishments since last report 72
4.2 Current state of the industry 76
4.3 Emerging issues 79
5.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS 82
6.0 STRATEGIC DIRECTIONS/PROBLEMS OR ISSUES/SECTOR PRIORITY 85
7.0 RECOMMENDATIONS ARISING FROM THE GAPS/BARRIERS/DEFICIENCIES 89
8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS: RESEARCH 105
9.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS: SERVICE 106

ONTARIO LIVESTOCK ENGINEERING RESEARCH AND SERVICES COMMITTEE

TABLE OF CONTENTS 111
1.0 EXECUTIVE SUMMARY 112
2.0 INTRODUCTION 113
4.0 CURRENT STATE OF THE INDUSTRY/RURAL SECTOR: 116
RECOMMENDATION NUMBER: 1 119
RECOMMENDATION NUMBER: 2 120

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

TABLE OF CONTENTS 133
1.0 EXECUTIVE SUMMARY 135
2.0 INTRODUCTION 137
3.0 SUBCOMMITTEE ACTIVITIES 137
4.0 STATE OF THE INDUSTRY 137
5.0 ACHIEVEMENTS 139
6.0 EMERGING NEEDS 139
7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS 142
8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS 143
9.0 DETAILED RECOMMENDATIONS 149
10.0 APPENDIX 153
11.0 RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE MEMBERSHIP 2001 154

1.0 EXECUTIVE SUMMARY

Edited by: Ron Fleming, P. Eng., University of Guelph - Ridgetown College

Listed below are the main research needs identified by the four engineering subcommittees. As the Plant Research Program is under review this year, recommendations from the Crops Engineering Subcommittee are highlighted. In addition, the top three recommendations from each of the other three subcommittees are listed here. A summary of all recommendations is found later in the report, as are full details of all new or revised recommendations. The subcommittee reports, in their entirety, are appended to this document.

The Engineering committee has held discussions about the most efficient and effective means of identifying research and service priorities in the future. These discussions are ongoing but will likely result in a major "strategic" report from each of the four subcommittees once every four years. These could be on a staggered schedule that provides for timely input into the main program reviews being carried out by OMAFRA/University of Guelph.

1.1 Crops Engineering

All recommendations are listed

1. **Rural energy issues -** There is a need to create a rural power quality benchmark based on a review of past and new fieldwork. This would provide a way to ensure power quality after deregulation in the spring of 2002. There will be large numbers of new small independent generators. Farmers will have an opportunity to produce some of their own power (stand-by generator, wind power, solar power, micro-hydro, methane, hybrid systems etc.) In light of the electrical market opening up there is a need to determine if low impact energy systems are feasible for rural Ontario. **(New Research Recommendation)**

2. **Rural roads and transporting equipment** safety - Rural road farm and non-farm traffic is increasing. There are a number of safety issues that need to be addressed urgently by the public and private sector. Lack of visibility is a major cause of many accidents. [Previous Service Recommendation]

3. **Development of new grain and forage processing (drying) systems** suitable for use with food-grade corn and for the conventional and organic production of alternate crops [Previous research recommendation]

4. **Development of applicators to apply manure and bio-solids** uniformly on the land at desired rates and odour control [Previous research recommendation]

1.2 Food Engineering

Top 3 research priorities – from a total of eight research and six service recommendations.

1. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life. Baking and frying processes modelling to improve baked and fried products' quality.

2. Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically de-boned chicken and sclerotia (black fungus) in beans. In-line sensors for microbial detection, moisture measurement at high temperature for baked foods and dough properties are required.

3. Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods.

1.3 Livestock Engineering

Top three research priorities – from a total of four research recommendations.

1. Development of Standards for the Construction of Manure Storage Structures and Manure Handling Systems: Full scale testing is needed to assess current construction techniques and their ability to produce **leak-proof** manure storage structures and transfer systems. **[Updated research recommendation]**

2. Integrity of Large Roof Systems: The snowfall experienced in the winter of 2000/01 caused partial roof collapse in approximately 14 large, newer swine buildings and in many older, deteriorated buildings. Since, in most cases, design snow loading was not reached, an industry-wide re-evaluation is currently taking place. The key to solving this problem is to ensure that appropriate engineering and inspection takes place. The roof truss industry and a group of consulting engineers have taken leadership in attempting to address these issues. Because of human safety issues, this work has a high priority [New research recommendation]

3. Measurement and improvement of air quality in livestock buildings: [Previous research recommendation]

1.4 Rural Environment Engineering

Top three research priorities – from a total of six research recommendations.

1. **Investigate methods by which farmers can determine if manure is present in tile water and what benchmark standards are appropriate.** This project involves developing techniques by which farmers can determine if manure is reaching tile water and at what levels. The technique must be quick and as simple as possible but attains reasonably accurate measurements. Standards must be identified and developed to support the testing procedure. **[New Research Recommendation]**

2. **Investigate environmental benefits of pasturing floodplain areas and identifying conditions under which the benefit may occur**. This project involves investigating the

environmental benefits of floodplain alternatives as compared to other land use practices that might occur e.g. row cropping, land tillage etc. Criteria to determine where floodplain pasturing would be appropriate and what other conditions need to be in place. **[New Research Recommendation]**

3.**To develop improved systems for applying manure** to no-till, hay, and pasture land and sensitive areas such as ground water recharge zones and shallow topsoil over bedrock areas more accurately, cost effectively and environmentally safe. [Previous research recommendation]

2.0 INDUSTRY / SECTOR SCAN

2.1 Crops Engineering

2.1.1 Major accomplishments since last report

- Hydro pole disconnect switch sizing rules changed by Ontario Hydro One. Potential savings for farmers have been estimated at $425,000 per thousand farmers who install pole switches.
- Several Factsheets on a variety of topics
- Canadian Standards Association standard for Farm P.T.O. generators
- Farm Vechicles & Equipment and the Highway Traffic Act. MTO Nov. 2000.
- Standby Power for Farms: booklet, manual, video, slide set, CD, sizing software
- Canadian Standards Association Technical Committee establishing standards for extremity lighting and equipment visibility

2.1.2 Current state of the industry

Ontario's agriculture and food industry contributes $25 billion to the provincial economy every year, and employs some 640,000 people. It is Ontario's second largest industry. To remain competitive, farmers must expand and adopt new, more efficient production methods. Sometimes, expanding or new farm operations encounter serious conflict with neighbours.

Farm, rural, environmental and urban groups are studying the issues that put farmers in conflict with their neighbours. In Ontario, food production and rural housing in the most part are neighbours. Good neighbours need to trust each other. One way to build trust is by having the agricultural operations do a Nutrient Management Plan.

In the near future there will be a consultation of the rural community with respect to standards for the new provincial Act - Bill 81 (Nutrient Management Act). These standards will help ensure that Ontario has adequate food supply, food safety, environmentally sound farm practices and minimum conflicts.

Machinery companies are starting to target large farms. The machinery companies are positioning themselves to service the fastest-growing segment of the agricultural market - that being the large-scale farming operations. For example, Caterpillar is producing a new super-large rotary combine with a 400 horsepower engine and a 67-inch threshing floor.

There is great debate going on in the USA that packers should not own hogs. The message came through loud and clear at the annual meeting of the Iowa Pork Producers Association (IPPA), held in Des Moines. In a member survey, 92% of pork producers in the state said IPPA should continue to lobby against packer-ownership of hogs or hog farms. *This debate may come to Ontario in the near future.* Country of origin labeling for meat was also debated. One resolution passed calling for this labeling on all meat animal protein, including poultry.

2.1.3 Emerging issues

- **Terrorist threat:** Pesticide dealers and applicators need to review safety procedures and "be extra vigilant during this time of continued terrorist threat". Farmers, aerial applicators, lawn care operators, exterminators and others who regularly store and use pesticides should review management practices Aerial applicators should be especially vigilant about securing equipment and chemicals. Pilots should report any suspicious activity relative to use, training or acquisition of dangerous chemicals or equipment
- **Value Enhanced Grains (VEG) -** Sophisticated markets are developing for agriculture products. Customers are seeking products that better meet their individual needs. Today the end user, be it a processor, livestock producer, or other value adding business is looking for higher quality products or specialized traits that provide an edge in a competitive marketplace. The agricultural system is uniquely equipped to meet these demands as advances in plant composition, agronomics, processing technologies, and infrastructure continue to develop at an ever-quickening pace. The demand by grain buyers for these new products is evidenced by the five-fold increase over the past few years in land dedicated just to the production of corn higher in oil content. Farmers who decide to grow Value Enhanced Grains (VEG) must be ready to segregate harvest and storage of these crops. This will also mean that companies down the food delivery line like processors will have to segregate also.
- The Canadian government may fast-track off-road **engine emission standards** for engines with less than 19 kW. The off road sector includes agricultural, construction and forestry equipment, lawn mowers, snowmobiles, ATV's etc. Canada will most likely develop emission standards similar to the U.S.A.

2.2 Food Engineering

2.2.1 Major accomplishments since last report

- Hugh Fraser (OMAFRA) spent about 20% of his time dealing with production engineering issues affecting the horticultural industry, including: rapid cooling options for produce; short and long-term storage; and shipping container options.
- Modeling alkaline phosphatase inactivation in bovine milk during high-temperature short-time pasteurization
- Reduction in levels of Escherichia coli O157:H7 in apple cider by Pulsed Electric Fields was tested
- An artificial neural network for the prediction of temperature, moisture and fat contents in meatballs during deep-fat frying was developed.
- Use of Artificial Neural Network to Predict Temperature, Moisture and Fat in Slab -Shaped Foods with Edible Coatings during Deep-Fat Frying was investigated.
- Research done on computer-based process control and decision-support in food processing.

- Quantitative Risk Assessment group was successful in obtaining funding for a three-year Strategic Grant "Microbial Food Safety – Integrated Modelling Techniques for Farm-to-fork Risk Assessment".
- Dr. Piyasena investigated the dielectric properties of food components (salt, sugar, mailc acid, starch, guar) as a function of temperature and frequency. Results indicated that these properties are influenced by temperature and the food components. These results will be used in developing a radio frequency based heating process for pasteurization of viscous and heat sensitive liquid food products.
- Methods for the measurement of polyphenoloxidase (PPO) in apple cider and lettuce were developed. These methods will be used in measuring the inactivation PPO in apple cider and to study the kinetics of browning of Ready-to-Use lettuce.
- Modified and further developed a user-friendly Pasteurization software in Visual C++ to calculate the microbial inactivation during different thermal process conditions in different equipment (HTST, RF etc.), operational conditions, and configuration.
- Dr. Piyasena continued to study the inactivation of Escherichia coli O157:H7, Pediococcus sp. and polyphenoloxidase during high-temperature short-time pasteurization of cider in order to find the safe pasteurization temperature-time combinations.
- Dr. S. X. Yang's (SOE) research is to model the lycopene extraction from tomato in supercritical CO_2 fluid extraction by conventional and soft computing approaches. This research includes modeling and analysis of supercritical fluid extraction using both conventional, soft computing, and hybrid approaches. The relationship between the extraction yield rate with temperature and pressure is studied using various modeling approaches. Optimization of extraction parameters of supercritical fluid extraction technology is carried out using genetic algorithms.

2.2.2 Current state of the industry

Down-sizing and consolidation of Canadian and U.S. operations continue to impact the structure of many Ontario food processing companies. Due to regional and global trade agreements, the food industry in Ontario is facing **international competition**. Downsizing is putting less emphasis on R & D. Resources in Engineering R & D are decreasing due to overhead cuts and profit oriented approach. Food engineers are leaving to other industries and consulting due to less job satisfaction.

R&D - Industry driven research in universities and federal institutions is a concern as these were driven on short term benefits. The consequence would be disastrous in long terms, as basic research goes down. In general processors want to do short term research. OMAFRA proposals require industry collaboration but it is not possible in most cases.

Less competition is being created due to merging as the number of owners are decreasing in each food sector. On the other hand, **Co-packing** is increasing where smaller food processors are processing foods for larger processors. For this reason and in general, small food processing companies are increasing in numbers. However, these smaller processors are facing the followings: 1. Need of R&D on process and product development, 2. Need of whole infrastructure, 3. Compliance of processing facility sanitary, product safety, and labelling requirements as per USDA/FDA regulation for export, 4. Expansion of process lines to increase the output, 5. Developing process lines for multiple use or multiple products, and 6. Producing more and more value added foods. These factors increase the demand for research done by public institutions.

Education and training of workforce to properly use modern technology is lacking in food industry compared to other industries such as automobile industry. Due to the use of newer technology a wide gap is created between technology and training of workers.

Induction training and Continuing education/training - As the industry displacement cycle (due to rapid change in technology) is becoming shorter and shorter, life long learning (retraining, retooling) of the workforce is becoming important to be competitive in the market. Exploring innovative and cost effective training methods such as Internet-based training are very important.

Qualified engineering graduates and trade personnel in food engineering - There is a shortage of food/food processing engineers in Ontario. Also, food engineering professionals are not paid well compared to other engineering disciplines such as electrical, electronic and computer engineering.

Nutritional issues are important for the industry. **Nutraceuticals** are being produced in Ontario, but progress is slow. There is a need for new processing methods such as cold processing to preserve the active ingredients while inactivating microorganisms. The industry and governments are slow to response to the increasing demand to these products and consumer awareness. Low rate of success of these products is due to lack of commercialization capabilities. Inventions die in the lab before even reach the pilot plants, as there are engineering problems that have to be solved.

Economic problems: For export, Canadian processed food is more attractive due to the low value of the Canadian dollar. However, imported equipment, machinery and raw material are more costly and it curtails innovation to improve productivity. The long-term consequence would not be good for Canada.

Energy management are needed by process and equipment modifications to reduce processing cost.

Mad cow disease in UK and Europe has created large demand for North American meats.

2.2.3 Emerging Issues

- **Safety and Quality:** Air quality in the plants must be maintained particularly where ovens are used. Discharging particles into air is becoming a problem. These particles are more harmful as they cause respiratory problems. Water quality for food processing is becoming more critical. Effective use of water and reuse of wastewater are needed. Odour and wastes discharged from processing plants is also becoming a major concern. Rapid and in-line methods for food analysis and quality control are required. Recycling/treatment of used water/waste water is becoming more important. Setting up water quality standards for different products (beer, wine, meats, etc.) is also becoming important.
- **Odour**: A standardized odour measurement method is required.
- **Food safety:** Reusing containers, especially in the meat industry, poses health risk. There is not any standardized procedure in place for cleaning.
- **Technological Challenge:** Computer-dependant technologies continue to be important within the industry. Advances in instrumentation, automation and software, vision systems, and wider implementation of HACCP related quality control systems are all leading to wider

use of computer technology. Vision scan and x-ray devices are needed for bruise detection on fresh produce, proper baking of cookies, and detection of worms and blood spots in food products.

- **Nutraceutical Processing**: Appropriate separation technology is needed to extract active ingredients from soybean, tomato, hemp, etc. Cold processing is required to avoid degradation of active ingredients. Research is also needed in purification and concentration of nutraceuticals.
- **Wine and beer Industry**: Due to the growth of wine and beer industry, especially microbreweries, in Ontario, there are research needs in the process engineering area. Micro breweries are facing some problems such as: how to be profitable, more needs in processing knowledge and expertise, and using old equipment that is less energy efficiency, and costs more to repair.
- **Byproduct Utilization and solid waste management**: Presently byproducts from many food industries are going for animal feeding. Research is needed to utilize the byproducts from corn, apple and grape processing industry.
- **Dead animal composting**: Pet food companies are not buying dead animals anymore for pet foods due the fear of mad cow disease, and antibiotics contents. As currently available incineration methods are expensive, low cost methods are being researched.
- **Processing plant by products**: Cataloguing the source, and the amount of food processing plant by-products such as pomace from apple, peach pits, carrot waste, and finding ways to dispose of them by composting has to be explored.

2.3 Livestock Engineering

2.3.1 Major accomplishments since last report

- **Air Quality in Livestock Buildings** – research ongoing at Univ. of Saskatchewan - 0.1 py, and at Univ. of Alberta - 0.1 py
- **Corrosion and Deterioration of Agricultural Building Components:** research at Univ. of Guelph 0.35 py
- **Manure tank design:** Innovative design of manure storage tanks (Univ. of Manitoba - 0.54 py). Also, a letter to the Standing Committee on Structural Design pertaining to the wording of the National Farm Building Code has been forwarded to the Standing Committee on Structural Design, NBCC in October 2001. In the interim, an emergency amendment to the Ontario Building Code is proposed. The proposed Nutrient Management Act requires the preparation of a comprehensive set of standards for all aspects involving the integrity of manure storage and transfer systems. Work is currently in progress.
- **Animal Comfort:** A behavioural and environmental study to develop improved gestation and farrowing accommodation for sows and litters (Lennoxville, Que - 2.0 py). Using natural convection to lower attic temperatures in controlled environment buildings (Univ. of Manitoba - 0.08 py). Low Energy Input Swine Housing Systems (Winnipeg, Manitoba - time unknown)
- **Corrosion of Roof Truss Gusset Plates** - A proposal has been re-submitted to the Standing Committee on Structural Design, NBCC in October 2001.
- **Technical Information for the Construction Industry:** Structural behaviour of nail-laminated posts (Univ. of Manitoba - 0.11 py). Several meetings have been organized and presented to the farm building industry, the roof truss industry and consulting engineers across Ontario, pertaining to the roof collapses experienced in the winter of 2000/01

2.3.2 Current state of the industry

The Ontario **beef** industry is moving into a time of optimism and growth. The industry is consolidating and being directed by stronger hands. The Ontario Cattle Feeders Association (approx. 3 years old) is showing a marked effect on the industry. Much of the cattle feeding is done on contract.

Optimism is still found in the **dairy** industry. The price of quota continues to rise – variable, but averaging $20,000/kg of butterfat. Barns continue to be constructed, both by immigrant producers, and established producers. Commercial robotic milking installations are becoming more common. A dozen or more farms are now operating exclusively with milking robots. Several companies are offering robots for sale: Lely, Prolion, Delaval, and Surge-Westfalia.

Swine barns continue to get bigger in size: 2400 sow barns and 2000 finishing barns are becoming the norm. Society's reaction to proposed swine barns being built is becoming widespread. Municipalities are reacting with restrictive by-laws in an attempt to minimize 'large' barns. Facilities with leaking manure tanks and manure transfer piping systems have been encountered.

Sheep production is increasing slightly, some as milking herds. There is a continued increased interest in **goat** operations.

Poultry producers continue to be very optimistic about this industry and seem prepared to invest big dollars in quota and new facilities. Interest continues to come from older dairy farmers who are switching between the two quota systems. Extremely high quota prices continue (broilers @ $42/unit; egg quota @ $80+/hen; turkeys @ $2.60/kg). Ontario has approximately: 1100 broiler producers; 200 pullet producers; 500 egg laying hen producers; and 160 turkey producers.

The greenhouse industry continues to expand, particularly in the Leamington area (cucumbers and tomatoes) and in Niagara (flowers). Non-traditional niche-market crops are being grown with unfamiliar post-harvest requirements.

Construction of tower silos remains at an all time low. Silo deterioration continues to be an ongoing challenge. Plastic from wraps, tubes, individual bags, etc. present local problems for recycling or disposal.

Building Engineering - Snow loading concerns have surfaced in large farm buildings. The recent collapse of up to 14 large buildings has sparked interest in the design process used for farm roofs. Building construction is still relatively active in Ontario. Typically, new livestock buildings are tending to be very large. Engineering is more prevalent in these larger structures. A larger contractor may have an on-staff engineer or may hire a private consultant to provide engineering details. Building officials are happy to share some of the responsibility for the structure with an engineer. Municipal restructuring means fewer, better trained building officials. There are currently less than 500 municipal building officials serving rural areas. It is expected that there will be approximately 350 by 2003. This is bringing about more even application of building codes in Ontario. OMAFRA continues its education program, directed toward the improved application of building codes in Ontario.

Environmental - A large number of swine, poultry and dairy operations are still being constructed in Ontario. Nutrient Management Plans are commonly being required by municipalities. Farmers are awaiting the final enactment of the proposed Nutrient Management Act. Public interest groups are becoming much more vocal against large livestock operations being constructed in their communities. Some municipalities have placed an interim control bylaw in effect to limit the construction of larger livestock operations until the Nutrient Management Act is finally enacted.

2.3.3 Emerging Issues

- ☐ The use of safety railings around openings in buildings and manure tanks and transfer pumps need to be addressed.
- ☐ Recent building collapses due to significant snow loading has resulted in the need to reconsider design methodology for farm roof construction. We require an improved, comprehensive design model to describe snow load distribution on large farm structures.
- ☐ Preventing manure leakage from barns and storages.
- ☐ Manure handling problems when sand bedding is used in free-stalls.
- ☐ Lower cost, covered manure storages for poultry.
- ☐ More cold storages will be used year round to spread out costs. This may create some vapour barrier problems with reversing vapour pressure gradients.
- ☐ There is a need for improved aeration systems for flat grain storages.
- ☐ Producers believe there is a need for research to provide information and technology to prevent or alleviate concerns regarding animal welfare and environmental sustainability in all sectors.
- ☐ Questions still remain regarding the use/operation of tunnel ventilation systems. We need information regarding the factors that affect tunnel ventilation.
- ☐ There is a concern about the time commitment, and type of cleaning equipment being recommended for cleaning barns between animal cycles. There is some speculation on the use of robotics for this task.
- ☐ Require full-scale building testing of manure storage and handling components to prove or disprove the integrity of current building techniques.
- ☐ Require development of comprehensive standards for all aspects of manure storage and handling.
- ☐ Investigate the use of a spray bar to reduce H_2S development in tanker or manure tank.
- ☐ Require increased odour control research for both inside barn air quality as well as around the buildings.
- ☐ Beef producers need to be able to lower costs of production by 20%. Simplified structures would assist. Some features might be modular construction, a roll-off roof, combination manure systems

2.4 Rural Environment Engineering

2.4.1 Major accomplishments since last report

- ☐ The only accomplishments documented in the subcommittee report this year were some of the courses/training sessions held during 2001, including: Primary Drainage Contractors Course, Feb. 2001; Municipal Officials Drainage Course - Apr. 2001; Concrete Manure Storage Design Course, 2001; Custom Manure Application Course, 2001; Pollution Control Course, 2001; Drainage Superintendents Course, 2001; Nutrient Management Sessions - 2001 (several); Ontario Environmental Farm Plan - 2001 All Ontario.

2.4.2 Current state of the industry

Soil, water, and air issues related to large livestock operations continue to dominate the agricultural industry. The primary stimulation is the construction of swine barns. The number of large swine and dairy operations are still on the increase. More and more municipalities are passing bylaws to try and control construction in an orderly fashion. Nutrient management plans, days of manure storage, and MDS II requirements are included in most bylaws. Interim control bylaws on large livestock building construction are common awaiting the proposed Agricultural Operations Act by the province. Variations occur when attempts are made to inventory land used for application of manure and guarantee application rates. Local resident organizations are still very vocal and well organized in presenting their concerns and demands. Municipalities are reacting accordingly.

Much attention is still focused on **bacteria and nitrates** as the primary contaminants in light of the Walkerton situation. Runoff from agricultural lands is being scrutinized from many fronts. Department of Fisheries and Oceans and Environment Canada are now getting involved more directly with situations that may be impacting fisheries in Ontario i.e. two incidents in Eastern Ontario where charges have been laid. Demands to protect and create riparian zones along waterways and wetlands is also still on the rise.

Phosphorous loading on streams is still a primary concern in many areas of the province. Many municipal treatment systems are dependent on rivers to assimilate treated wastewater from cities and towns. Assimilative capacities of some rivers have reached or are reaching the maximum levels permitted. Municipalities are searching for cost-effective alternatives such as "phosphorous trading" or "phosphorous credit" type accounting systems based on improvements to agricultural land and nutrient management techniques.

The **Environmental Farm Plan** process went through its eighth full year of operation and distributed close to 2000 workbooks which is consistent with previous years. This program is in jeopardy as it is in its final year of funding and new sources of monies have not been secured.

Activity in tile **drainage installation** is stable and similar to previous years.

The Department of Fisheries and Oceans, in consultation with stakeholders, has developed a Class Authorization system for the maintenance and repair of existing municipal drains. They, in partnership with local Conservation Authorities, have funded the collection of data to catalogue the fish habitat that currently exists in municipal drains. This information is used to classify each municipal drain into six different categories. As a result, municipal drainage superintendents will be able to receive a "class authorization" for their proposed work, provided they follow the predefined conditions for that drain. This positive development promises to minimize the frequent conflicts between municipalities and environmental agencies in the maintenance and repair of existing municipal drains.

2.4.3 Emerging Issues

- Municipal Nutrient Management and Interim Control Bylaws to Control Development of Large Livestock Operations.

- ☐ Community Resentment Towards the Establishment of Large Swine Operations
- ☐ An Accelerated Rise in Public Scrutiny, Interest and activity in Non-traditional Components of Water Pollution. Primarily is focused on pathogens but is likely to progress to nitrates in the future.
- ☐ Application of Biosolids on Agricultural Land is Receiving Increased Scrutiny with Equal Attention as Livestock Manure.
- ☐ Large Water System Regulations Require Well Head Studies which are Likely to Lead to Well Head Protection Plans and Likely to be Restrictive to Some Agricultural Activities. Small Water Systems are Under Review as well. Consultations Are Completed and further Regulations are being Considered.
- ☐ Municipal WasteWater Treatment Systems At Capacity and Looking at Less Costly Alternatives – Phosphorous Offset Methods.
- ☐ Draught Conditions Have Passed but Discussions on Water Rights and Allocation Will Continue.
- ☐ Greater Demand for Better Weather Forecasting and Networking for Better Management of Land Application of Manure and Biosolids as Well as for Surface Water Supply Management.
- ☐ Drainage Looked at as Contributor to Low and High Flow Rates in Streams as Well as Water Quality Problems.
- ☐ Methane - Greenhouse Gas from manure.
- ☐ Vegetable Wash Water Quality and Legislation
- ☐ Livestock Access to Streams and Conflict with Fisheries Act
- ☐ Irrigation Water Quality and Food Safety
- ☐ Nutrient Management Bylaw and Plan Court Challenge
- ☐ Impacts of weather to runoff and infiltration.
- ☐ Farmers having more and more difficult time recognizing how and where to protect the ground water.
- ☐ Stream management and livestock access still an issue but options are required.
- ☐ Non-traditional contaminants related to manure will gather additional attention.

3.0 REPORT OF ACTION TAKEN SINCE LAST ANNUAL REPORT

Most of this material has been covered in the previous section under the heading of Major Accomplishments. New programs begun in 2001:

Special Research Program – 2001 - Thirty-three research projects were approved for funding through the Special Research Program in 2001 in the following areas by OMAFRA: Value-added food and non-food products, Alternative livestock species in Ontario, Antimicrobial resistance, Food safety risk assessment and risk control, A healthy environment Pesticide reduction and usage.

New Directions in Agri-Food and Rural Research Program – 2002 - For 2002, the Special Research Program has been renamed the New Directions in Agri-food and Rural Research Program to better reflect its intent by OMAFRA. The priorities for research in 2002 are: Value-added food, Value-added Non-food Uses of Agricultural Materials, Alternative Livestock Species, Healthy Environment, including Rural Issues, and Pest Management.

WASTE DIVERSION ACT, 2001 - BILL 90 - The Waste Diversion Act is enabling legislation that will allow for the development of an organization, regulations and programs to address waste diversions in Ontario. Key designated wastes being considered are: Blue Box materials including consumer packaging (food and beverage containers made of aluminum, steel, glass and plastic), newspaper, cardboard and box board. Industry will be expected to pay for up to half of the net costs of the Blue Box program. The other half will come from municipalities.

4.0 ISSUES

See the previous section under the headings "Emerging Issues" for a complete listing.

5.0 RECOMMENDATIONS ARISING FROM THE IDENTIFIED ISSUES

Following is a summary of the individual recommendations for research and services from each of the four subcommittees. This is a complete list of recommendations. Complete details for all new recommendations may be found in the next section of this report. Details for recommendations that are carried forward from past years (still important but not adequately addressed) are found in the appended subcommittee reports.

5.1 Crops Engineering

1. **Rural energy issues -** There is a need to create a rural power quality benchmark based on a review of past and new fieldwork. This would provide a way to ensure power quality after deregulation in the spring of 2002. There will be large numbers of new small independent generators. Farmers will have an opportunity to produce some of their own power (stand-by generator, wind power, solar power, micro-hydro, methane, hybrid systems etc.) In light of the electrical market opening up there is a need to determine if low impact energy systems are feasible for rural Ontario. **[New Research Recommendation]**

2. **Rural roads and transporting equipment safety** - Rural road farm and non-farm traffic is increasing. There are a number of safety issues that need to be addressed urgently by the public and private sector. Lack of visibility is a major cause of many accidents. [Previous Service Recommendation]

3. **Development of new grain and forage processing (drying) systems** suitable for use with food-grade corn and for the conventional and organic production of alternate crops [Previous research recommendation]

4. **Development of applicators to apply manure and bio-solids** uniformly on the land at desired rates and odour control [Previous research recommendation]

5.2 Food Engineering

1. **Improved technologies for pasteurization** such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life. Baking and

frying processes modelling to improve baked and fried products' quality. [Previous research recommendation]

2. **Image processing** for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically de-boned chicken and sclerotia (black fungus) in beans. In-line sensors for microbial detection, moisture measurement at high temperature for baked foods and dough properties are required. [Previous research recommendation]

3. Development of efficient methods for **separation, purification and concentration of nutraceuticals** from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods. [Previous research recommendation]

4. **By product utilization and waste management** [Previous research recommendation]

5. **Raw material characterization** for food product quality. [Previous research recommendation]

6. **Optimizing material handling in wine and beer industry**. [Previous research recommendation]

7. **Process development for new products for small processors** [Previous research recommendation]

8. **New material to replace stainless steel and to use in new processes [New research recommendation]**

SERVICE PRIORITIES

1. Providing induction **training and continuing education**/training for employees in food processing sector, producing more qualified food engineering graduates and trade personnel, and the recognition of food engineering professions.

2. Setting up **water quality standards** for different products (beer, wine, meats, etc.) and standardized odour measurement method

3. **Streamlined and harmonized food inspection regulations** at all three levels of government (federal, provincial and municipal).

4. **Support for HACCP** set up, and provide funding for small processors to upgrade the processing equipment.

5. **Regulations for reusable containers in the meat industry**.

6. Developing a **stream lined universal research proposal application form** and evaluation process by the funding agencies and institutions.

5.3 Livestock Engineering

1. **Development of Standards for the Construction of Manure Storage Structures and Manure Handling Systems:** Full scale testing is needed to assess current construction techniques and their ability to produce **leak-proof** manure storage structures and transfer systems. **[Updated research recommendation]**

2. **Integrity of Large Roof Systems**: The snowfall experienced in the winter of 2000/01 caused partial roof collapse in approximately 14 large, newer swine buildings and in many older, deteriorated buildings. Since, in most cases, design snow loading was not reached, an industry-wide re-evaluation is currently taking place. The key to solving this problem is to ensure that appropriate engineering and inspection takes place. The roof truss industry and a group of consulting engineers have taken leadership in attempting to address these issues. Because of human safety issues, this work has a high priority **[New research recommendation]**

3. Measurement and improvement of air quality in livestock buildings [Previous research recommendation]

4. Measurement and prevention of corrosion and deterioration of agricultural building components [Previous research recommendation]

5.4 Rural Environment Engineering

1. **Investigate methods by which farmers can determine if manure is present in tile water and what benchmark standards are appropriate.** This project involves developing techniques by which farmers can determine if manure is reaching tile water and at what levels. The technique must be quick and as simple as possible but attains reasonably accurate measurements. Standards must be identified and developed to support the testing procedure. **[New Research Recommendation]**

2. **Investigate environmental benefits of pasturing floodplain areas and identifying conditions under which the benefit may occur**. This project involves investigating the environmental benefits of floodplain alternatives as compared to other land use practices that might occur e.g. row cropping, land tillage etc. Criteria to determine where floodplain pasturing would be appropriate and what other conditions need to be in place. **[New Research Recommendation]**

3. **To develop improved systems for applying manure** to no-till, hay, and pasture land and sensitive areas such as ground water recharge zones and shallow topsoil over bedrock areas more accurately, cost effectively and environmentally safe. [Previous research recommendation]

4. **To evaluate and quantify the impact of large livestock operations on the rural environment**. [Previous research recommendation]

5.To investigate and adapt **alternative treatment process methods to reduce odours** from livestock manure and make for a safer product to apply to the land. [Previous research recommendation]

6.To **identify sources of microbiological and pathogen related water contamination** in agricultural watersheds and put into perspective the various contributors. [Previous research recommendation]

5.5 Detailed Recommendations

The recommendations listed are those that are new or that have had significant changes from previous annual reports. Details for the complete list of recommendations may be found in the subcommittee reports appended.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Crops Engineering - Recommendation #1

Issue:	Rural Energy
OASCC Linkage:	Animal, agricultural economics, rural
Target Agencies:	Recommendation to AAFC, ARIO, CC, CARC, and OMAFRA
Title:	Rural Energy Issues

Details:
Research is needed
1. To create a benchmark of rural electrical power quality - [farm or off-farm power]
2. To determine the feasibility of Low Impact Renewable energy systems for rural Ontario

Background:
In the spring of 2002, the Ontario electrical market will be deregulated. There is a need to create a current rural power quality benchmark based on review of past and new fieldwork. This benchmark of power quality would provide a way to ensure power quality in the "new world" after de regulation. There will be large numbers of new small independent generators.

Farmers will also have an opportunity to produce some of their own power (stand-by generator, wind power, solar power, micro-hydro, methane, hybrid systems etc.) In light of the electrical market opening up there is a need to determine if low impact energy systems are feasible for rural Ontario.

Co-generation: Farmers will have an opportunity to produce some of their own power (stand-by generator, wind power, solar power, micro-hydro, hybrid systems etc.) will be able to sell that power back to the utility. For large operations, the selling price will likely be based on the wholesale rate but, for smaller operations and residential customers, the utility will simply allow the meter to run backwards (i.e. the customer offsets the retail cost of power).

On Peak "Shaving" or Peak Demand Reduction. Utilities and power re-sellers may offer incentives to their larger customers to reduce power consumption during times of peak demand. A farmer may wish to use a stand-by generator to produce power during peak demand times if the incentive is sufficiently attractive. In considering options of this nature, a full analysis of the cost-benefit of the choices should be conducted.

Power Quality: Sites that have a small independent power source, or one utility transformer that supplies a number of users, such as strip malls and large buildings, are particularly prone to power quality problems. This is because both disturbing and sensitive loads share the same power supply. In addition, the individual loads can represent a very large proportion of the total amount of electricity supplied to the building, so that changes in voltage can be very significant when one of these loads is turned on or off.[Source Canadian Electrical Association National Power Quality Survey, CEA Report 220D 711 A] In 1991, the Canadian Electrical Association undertook a three-year study of power quality in Canada called the National Power Quality Survey*. Twenty-two utilities across the country performed monitoring for a month at over 500 sites.

The target frequency should be maintained between 58 and 62 Hz. Most equipment is not adversely affected by minor changes in frequency, however, timing devices and clocks which rely on frequency for accuracy will be affected directly with changes in frequency (i.e. 5% high on frequency, clocks run 5% faster and gain 3 minutes/hour).

In the future there will be a growth in small independent power companies supplying power to farmers and in farmers generating there own power. Farmers will have to ensure that the power produced by them or bought from small independent producers meets standards. If power is over or under voltage there can be many problems.

Power quality disturbances are deviations from the specified voltage and frequency delivered by the utility that can cause problems with sensitive electrical and electronic equipment. Problems experienced include loss of computer data, malfunctioning electronic equipment, flickering, dimming or brightening of lights, increased need for equipment servicing or decreased life of electronic equipment, overheated equipment, blown fuses and overheated or tripped breakers and fuses.

If a transient occurs on the electrical distribution system and it falls outside of the Acceptable Voltage Tolerance Envelope then a "soft failure" or malfunction of electrical equipment such as a computer "lock up" or equipment resetting, or "hard failure" causing permanent damage (burn out) may occur.

Currently many sectors of the economy are concerned about energy supply, security and stable long-term prices. Low impact energy system would deliver secure supplies, and long term fixed costs. Promoting low impact energy would help Canada to meet its Kyoto Protocol of reduced green house gas [GHG] emissions. Some reports indicate that Canada could reduce GHG emissions by 5 to 10 percent if low impact energy systems were promoted. Promotion of low impact energy systems would stimulate the economy, create new high tech employment, and help Canada meet its Kyoto GHG commitment.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Food Engineering Subcommittee - Recommendation #8

Issue: New materials

OASCC Linkage: Food processing committee

Target agencies: Recommendation to AAFC, ARIO, CC, OMAFRA

Title: New material to replace stainless steel and to use in new processes

Details:
New materials other than stainless steel (such as polyethylene tanks, PVC piping, ceramics, aluminum) for storage, handling, and processing of food materials are being used more and more in food processing. However, there is insufficient information available on the interaction between the food and these materials, and safety of their use. Further, the new processes such as pulse electric field, ultrasound, and radio frequency heating require special material other than stainless steel to withstand the high voltage, ultrasound, and high pressure at high temperatures. Therefore, there is a need for research to develop and evaluate new materials for specific process as well as their interaction between food and safety.

Background:
The industry, research institutions and academic researchers should address this recommendation.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Food Engineering Subcommittee – Service Recommendation #1

Issue: continuing education

OASCC Linkage: Food processing committee

Target agencies: Recommendation to ARIO, CCF, universities and OMAFRA

Title: Providing induction training and continuing education/training for employees in the food processing sector, producing more qualified food engineering graduates and trade personnel, and the recognition of food engineering professions

Details:

As the industry displacement cycle (due to rapid change in technology) is becoming shorter and shorter, life long learning (retraining, retooling) of the workforce is becoming important to be competitive in the market. It would be very expensive for the small processing companies to do the training on their own. Therefore, exploring innovative and cost effective training methods such as Internet-based training are very important.

Every single employee/operator should be trained before using a piece of equipment; he or she should understand the operational, safety, principle, and basic trouble shooting skills. Government should make this is mandatory and enforce it properly.
There is a shortage of food engineering graduates and trade personnel in Ontario. Further New graduates (college and university) lack hands on experience, critical points judgement skills, and other judgement skills.

Food engineering professionals are not paid well compared to other engineering disciplines such as electrical, electronic and computer engineering. Therefore, it is very difficult to attract enough candidates to be trained in food engineering. Further, food engineering professionals are poorly paid in the government institutions compared to their counter parts in the private sector and in private practice. Therefore, it is very difficult to attract talented engineers to government institutions to work as researchers, inspectors, and advisors.

Background:

The food manufacturing industry is facing increasing global competition, government regulations and consumer demands. These challenges require adoption of new technologies and methodologies to create and sustain a competitive advantage in the marketplace. Therefore, the workforce in food processing industry should have the knowledge, tool and experience to handle the rapidly changing technologies and regulations.

The recommendation should be addressed by universities, food industry, GFTC, and federal and provincial governments. The training activities at GFTC, and UOG should be strengthened and expanded to include and increase more food engineering components. Further, co-op programs at federal government institutions (such as AAFC) and industries should be expanded to include more students.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Food Engineering Subcommittee – Service Recommendation #2

Issue:	Water quality standards
OASCC Linkage:	Food processing committee
Target agencies:	Recommendation to ARIO, CCF, Environment Canada and OMAFRA
Title:	Setting up water quality standards for different products (beer, wine, meats, etc.) and standardized odour measurement method.

Details:
Search for quality and quantity of water is becoming very important. Processing plants requires a large amount of good quality water. Currently the industries are not metered. However, in the future everyone in Ontario will be metered to monitor the water use regardless of the source. Therefore, recycling/treatment of used water/waste water becomes important. Setting up water quality standards for different products (beer, wine, meats, etc.) is necessary.
Standardized odour measurement method is also required (such standard exists in Australia) to control this issue effectively.

Background:
The recommendation should be addressed by research institutions and universities, food industry, ARIO, CCF, and OMAFRA, and Environment Canada.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Food Engineering Subcommittee – Service Recommendation #3

Issue:	food inspection regulations
OASCC Linkage:	Food processing committee
Target agencies:	Recommendation to AAFC, ARIO, CARC, CCF, Health Canada and OMAFRA.
Title:	Developing stream lined and harmonized food inspection regulations at all three levels of government (federal, provincial and municipal) for all sizes of food processing facilities

Details:
Food safety is the number one issue in food industries. An out break can kill a company overnight and bring great political pressure on governments. Even though the safety record of Ontario food industry is good, government should make sure that the adequate preventive measures are in place. Further, the recent report on food safety by Auditor General of Ontario should also be taken into consideration. In Ontario there are 3 levels of governments (federal, provincial and municipal) that are involved in regulation of food industry. Food inspection regulations should be stream lined and it should be the same at all 3 levels of governments and for all sizes of food processing facilities.

Regulation and enforcement should be carried out without any size limitation and there should be a mechanism in place to make sure that the HACCP is practised by the processors and properly enforced by the inspectors.

Background:
The recommendation should be addressed by food industry, AAFC, ARIO, CARC, CCF, Health Canada and OMAFRA.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Food Engineering Subcommittee – Service Recommendation #4

Issue:	Support for HACCP
OASCC Linkage:	Food processing committee
Target agencies:	Recommendation to ARIO, CCF, CFIA and OMAFRA
Title:	Lack of support for HACCP set up, and fund for small processors to upgrade the processing equipment.

Details:
Food safety is the number one issue in food industries. An out break can kill a company overnight and bring great political pressure on governments. Even though the safety record of Ontario food industry is good, government should make sure that the adequate preventive measures are in place. Further, the recent report on food safety by Auditor General of Ontario should also be taken into consideration. There should be a mechanism in place to make sure that the HACCP is practised by the processors and properly enforced by the inspectors. Therefore, OMAFRA should help the small processors to set up HACCP and also assist in upgrading the equipment that are inefficient and not comply with the current regulations.

Background:
There are more and more small food processors getting into the market. Smaller food processors are very innovative, and people with good technical and business background and ideas. They target value-added products and products for niche markets. However, they need support for the construction of processing plant and HACCP set up.

The recommendation should be addressed by ARIO, CCF, CFIA and OMAFRA

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Food Engineering Subcommittee – Service Recommendation #5

Issue: Regulations for reusable containers in the meat industry

OASCC Linkage: Food processing committee

Target agencies: Recommendation to AAFC, ARIO, CCF, CFIA and OMAFRA

Title: Setting up (OMAFRA) regulations for food processing plant construction and cleaning procedure for reusable containers in the meat industry

Details:

Reusing containers, especially in the meat industry, poses health risk. There is not any standardized procedure in place for cleaning. Therefore, it is not very easy for the HACCP and other regulations to be enforced. Further, such regulations would be helpful to the food inspectors.

Background:

The recommendation should be addressed by food industry, AAFC, ARIO, CCF, CFIA and OMAFRA.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Food Engineering Subcommittee – Service Recommendation #6

Issue:	universal research proposal application process
OASCC Linkage:	Food processing committee
Target agencies:	Recommendation to AACF, ARIO, CARC, CCF, Health Canada and OMAFRA.
Title:	Developing a streamlined universal research proposal application form and evaluation process by the funding agencies and institutions.

Details:
Canadian food processing companies are being bought by US and European companies. Companies are cutting cost, R & D budgets are reduced, and most of the R&D went to USA. New companies such as Mapleleaf, invest in R&D. However, generally, less money is invested in R&D by the food industry. We also lack the industry shared (commodity based and/or product based: e.g.: wine, beer, cereal, dairy etc.) national basic and applied research projects as in Japan and Europe, where a national project is shared by different universities, industries, and research institution across the nation or continent.

Developing a stream lined universal research proposal application form and evaluation process by the funding agencies and institutions would help the applicants as they do not need to rewrite the proposal from agency to agency and from institution to institution.

Industry involvement in research proposal evaluation, approval, is lacking. Currently, it is done mostly by academics. Participation from the industry should be increased.

Background:
As fund available for research is decreasing and the demand and competition for such fund are increasing, the government institutions and agencies at all levels and the other funding institutions such as commodity groups and associations should get involved in this process.

The recommendation should be addressed by food industry, federal and provincial government institutions and agencies (OMAFRA, CFI, AAFC, Health Canada, and CFIA), ARIO, CARC, CCF, and commodity groups and associations that fund research.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Livestock Engineering Subcommittee – Recommendation #1

Issue: manure system standards

OASCC Linkage: Animal Committee

Target agencies: Recommendation to ARIO, CARC, OMAFRA, and Standing Committee on Structural Design, NBCC

Title: Development of Standards for the Construction of Manure Storage Structures and Manure Handling Systems

Details:
The proposed new Nutrient Management Act will require the development of appropriate standards to ensure that manure storage and handling systems have a high level of integrity

Research is needed:
1. To assess current construction techniques and to verify the integrity of the manure storage system in a full scale building test.

Applied Research is needed:
2. To develop standards for all types of manure storage, liners, transfer piping, etc.
3. To develop inspection protocols to ensure a uniform and appropriate level integrity.
4. Changes to the National Farm Building Code are necessary to ensure that all components of the manure storage and handling system are regulated.

Background:
Issues related to integrity of manure storage and transfer plumbing have been encountered in the past several years. We need to know if shrinkage cracking in concrete floors and walls will allow the passage of manure in significant quantity. As well, construction joints need to be evaluated for their ability to protect against manure leakage. A full-scale project, utilizing a newly constructed livestock facility would provide much needed data to assist us in determining the integrity of current construction methods.

Cost/Benefit: It is estimated that the research needed to address these concerns could potentially cost approximately $100,000. Since it is difficult to put a price on clean water, it is safe to say that research dollars spent on this item would be well placed.

Resources: Ontario Pork, OMAFRA and the University of Guelph are committed to further research. OMAFRA is currently involved in the preparation of standards for components of manure storage and handling systems.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Livestock Engineering Subcommittee – Recommendation #2

Issue: structural design

OASCC Linkage:

Target agencies: Recommendation to OMAFRA and the Standing Committee on Structural Design, NBCC

Title: Integrity of Large Roof Systems

Details:
Responsibility for the design and inspection of large roof systems has been misinterpreted and has not received uniform application across Ontario. It is important to establish acceptable protocols and to ensure that a proper education process is developed.

Applied Research is needed:

1. To develop appropriate design parameters for very large livestock structures that are becoming very common.
2. To make recommendations to the Standing Committee on Structural Design, NBCC regarding roof design for agricultural structures.
3. To develop inspection protocols to ensure a uniform and appropriate level of safety.
4. To carry out a province-wide education/awareness program.

Background: The winter of 2000/01 proved to be a difficult one for large swine buildings in various provinces. In Ontario approximately 14 similar buildings suffered partial roof collapse. As well many older, deteriorated buildings collapsed or were damaged by the snow loading. In most cases, design snow loading was not reached. This leads us to conclude that there were shortcomings in the installation of the roof trusses. Items that must be considered: Who is ultimately responsible for the roof design? What design role does the roof truss engineer and supplier play in the process? A new proposal has been set out. Lateral bracing of compression web members (and the lack of a corresponding tie-off) is one of the major factors in the collapses experienced last winter. A task force has been looking into new methods of calculating roof loading as prescribed in the National Building Code. The roof truss industry and a group of consulting engineers have taken leadership in attempting to address these issues.

Cost/Benefit: This is a service oriented task. It is estimated that the cost of establishing design guidelines is relatively small, considering the donation of time from all participants. An estimate of cost to the industry is $50000. The cost of structural damage and lost production, considering only the 14 relatively new buildings is measured in the millions of dollars. Rate of payback is very high.

Resources: OMAFRA, the Ontario Wood Truss Fabricators Association, the Canadian Truss Plate Institute and a group of consulting engineers are working to establish a protocol for the design of these large roof systems

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Rural Environment Engineering Subcommittee – Recommendation #1

Issue: water quality

OASCC Linkage:

Target agencies: Recommendation to AAFC, ARIO, CC (Natural Resources)

Title: Investigate methods by which farmers can determine if manure is present in tile water and what benchmark standards are appropriate.

Details:
This project involves developing techniques by which farmers can determine if manure is reaching tile water and at what levels. The technique must be quick and as simple as possible but attains reasonably accurate measurements. Standards must be identified and developed to support the testing procedure.

BACKGROUND:
Manure is applied in a short period of time and if manure is reaching the tile water it must be detected quickly or damage will occur before it is found out. Sending samples to a lab is too slow in order to react to a situation. Testing must be done in-situ to be effective. In order to support in-situ testing, standards need to be developed which would indicate if an environmental situation were occurring or about to. The standard does not need to be legislative standard unless one exists but more an indicator standard to afford the farmer an opportunity to react to and avoid environmental incidents. Visual identification of tile water is the primary indicator of manure reaching the water. That technique generally is not considered to be acceptable but is the best method available.

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

Rural Environment Engineering – Recommendation #2

Issue:	
OASCC Linkage:	Food processing committee
Target agencies:	Recommendation to AAFC, ARIO, CC (Natural Resources)
Title:	Investigate environmental benefits of pasturing floodplain areas and identifying conditions under which the benefit may occur.

Details:
This project involves investigating the environmental benefits of floodplain alternatives as compared to other land use practices that might occur e.g. row cropping, land tillage etc. Criteria to determine where floodplain pasturing would be appropriate and what other conditions need to be in place.

BACKGROUND:
There is continuous debate regarding cattle access to streams. One side of the issue defending a historical practice of allowing cattle to water from all types of streams and the other side accept only full withdrawal from the stream and full fencing. In many areas of the province, there are floodplains adjacent to stream, rivers and ditches. These floodplains are often difficult to maintain fencing due to flooding and ice. Permanent fencing is impossible to keep in place. Until such time that a flood and ice resistant fence is developed, reality indicates that many of these floodplain areas will be pastured or tilled and cropped. Pastures provide excellent buffer areas. If tilled these areas could contribute significant soil loading to the stream and perhaps de-stabilize the bank itself. So the question is “are there floodplain conditions” near channels that warrant livestock access to the stream with BMP’s implemented as compared to other possible land uses such as row crops, conventional tillage etc. which would result in increased phosphorous loading. These questions need science-based answers.

6.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

Engineering recommendations to:

AAFA	Agriculture & Agri-food Canada		
ARIO	Agricultural Research Institute of Ontario		
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs		
CC	Canada Committees	1 =	Natural Resources
		2 =	Crops
		3 =	Animals
		4 =	Food
CARC	Canadian Agricultural Research Council		
MOE	Ontario Ministry of the Environment		
FS	Farm Safety Association		

6.1 Crops Engineering

Recommendation	AAFC	ARIO	CC	CARC	OMAFRA	OTHER
1. RURAL ENERGY ISSUES – research	x	x	1,2	x	x	
2. Grain and Forage Processing (Drying) – research	x	x	1,2	x	x	
3. Solid & Liquid Manure plus Bio-solids Applicators Ability to Apply Manure & Bio-Solids Uniformly on the Land and control odour. - research	x	x	1,2	x	x	

6.2 Food Engineering

To Agencies

Research Recommendations	AAFC	ARIO	CCF	CARC	OMAFRA	Other
1a. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life	X	X			X	
1b. Baking and frying processes modelling to improve baked and fried products' quality.	X	X			X	
2a. Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically de-boned chicken and sclerotia (black fungus) in beans	X	X			X	
2b. In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties	X	X	X		X	
3. Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.)	X	X			X	
4. By-products utilization, waste management and air and water pollution control.	X	X	X		X	
5. Raw material characterization for food product quality	X	X			X	
6. Optimizing material handling in wine and beer industry	X	X	X		X	
7. Process development for new products for small processors	X	X	X		X	
8. New material to replace stainless steel	X	X	X		X	

To Agencies

Service Recommendations	AAFC	ARIOCC	F	CARC	OMAFRA	Other
1. Providing induction training and continuing education/training for employees in food processing sector, producing more qualified food engineering graduates and trade personnel, and the recognition of food engineering professions.		X	X	X	X	UOG
2. Setting up water quality standards for different products (beer, wine, meats, etc.) and standardized odour measurement method.		X	X		X	Env. Canada
3. Stream lined and harmonized food inspection regulations at all three levels of government (federal, provincial and municipal).	X	X	X	X	X	CFIA, Health Canada
4. Support for HACCP set up, and provide funding for small processors to upgrade the processing equipment.		X	X		X	CFIA
5. Regulations for reusable containers in the meat industry.	X	X	X		X	CFIA
6. Developing a stream lined universal research proposal application form and evaluation process by the funding agencies and institutions.	X	X	X		X	CFIA, Health Canada

6.3 Livestock Engineering

To Agencies

Recommendation	AAFC	ARIOCC		CARC	OMAFRA	OTHER
1.Development of Standards for the Construction of Manure Storage Structures and Manure Handling Systems		X	X	X	X	*NFBC
2.Integrity of Large Roof Systems					X	*NFBC
3.Air quality in livestock buildings	X	X	X	X		
4.Corrosion And Deterioration Of Agricultural Building Components	X	X	X	X		*NFBC

*National Farm Building Code for Canada (Standing Committee on Structural Design, NBCC)

6.4 Rural Environment Engineering

To Agencies

RECOMMENDATION	AAFC	ARIO	CC	CARC	OMAFRA	OTHER
1. To develop improved systems for applying manure to no-till, hay, and pasture land and sensitive areas such as ground water recharge zones and shallow topsoil over bedrock areas more accurately, cost effectively and environmentally safe.	x	x	x 1			
2. To evaluate and quantify the impact of large livestock operations on the rural environment.	x	x	x 3			MOEE
3. Investigate and adapt alternative treatment processes to reduce odours from livestock manure and make for a safer product to apply to the land.	x	x	x 3			
4. To identify sources of microbiological and pathogen related water contamination in agricultural watersheds and put into perspective the various contributors.	x	x	x 1			MOEE
5. To develop a standardized test for manure odour-reducing			x			

additives. (Adequately serviced for present)	x	x	3			

APPENDICES

Appendix I : **Committee and Subcommittee Membership**

Appendix II : **Subcommittee Reports**

- **•Crops Engineering Research & Services Subcommittee**
- **•Food Engineering Research & Services Subcommittee**
- **•Livestock Engineering Research & Services Subcommittee**
- **•Rural Environment Engineering Research & Services Subcommittee**

Appendix 1 – Membership Lists

Ontario Agriculture and Food Engineering Research and Services Committee 2001

Name	Organization	Address	phone/fax/email
Ron Fleming Chair OAFERSC	University of Guelph	Ridgetown College Ridgetown, Ontario N0P 2C0	ph: 519 674 1612 fax: 519 674 1600 rfleming@ridgetownc.uoguelph.ca
Steve Clarke chair: Crops Eng. Subcommittee	OMAFRA	Box 2004, Provincial Bldg. Kemptville, Ontario K0G 1J0	ph: 613 258 8305 fax: 613 258 8392 sclarke@omafra.gov.on.ca
Punidadas Piyasena chair: Food Eng. Subcommittee	Agriculture & Agri-Food Canada	Food Process Engineering Food Research Program 93 Stone Rd West, Guelph, Ontario N1G 5C9	ph: 519 829 2400 x 3147 fax: 519 829 2600 piyasenap@em.agr.ca
John Johnson chair: Livestock Eng. Subcommittee	OMAFRA	667 Exeter Road London, Ontario N6E 1L3	ph: 519 873 4096 fax: 519 873 4062 jjohnson@omafra.gov.on.ca
Jim Myslik chair: Rural Env. Eng. Subcommittee	OMAFRA	ARD, Wellington Place R. R. # 1 Fergus, Ontario N1M 2W3	ph: 519 846 0941 fax: 519 846 8178 jmyslik@omafra.gov.on.ca
George Garland	OMAFRA	Resources & Regulations Branch 1 Stone Road West Guelph, Ontario N1G 4Y2	ph: 519 826 3560 fax: 519 826 3259 ggarland@omafra.gov.on.ca
Ben Hawkins	University of Guelph	Parish Bldg., Kemptville College Kemptville, Ontario K0G 1J0	ph: 613 258 8336 x 458 fax: 613 258 8285 bhawkins@kemptvillec.uoguelph.ca
Doug Joy	University of Guelph	School of Engineering Guelph, Ontario N1G 2W1	ph: 519 824 4120 x 3048 fax: 519 836 0227 djoy@uoguelph.ca
Chris Kinsley	University of Guelph	Collège d'Alfred 31 St. Paul St. Alfred, ON K0B 1A0	ph: 613 679 2218 x 609 fax: 613 679 2420 ckinsley@alfredc.uoguelph.ca

Crops Engineering Committee Membership 2002

Steve Clarke Chairperson Ph: 613-258-8305 Fax: 613-258-8392	Ont. Min. Agr. Food & Rural Affairs ORC Building, Box 2004 Kemptville, On K0G 1J0 Email: sclarke@omafra.gov.on.ca
Ben Hawkins Ph: 613-258-8458 Fax:613-258-8384	Kemptville College, University of Guelph Assoc. Director, Box 2004 Kemptville, On K0G 1J0 Email: bhawkins@kemptvillec.uofguelph.ca
Steve Matisz Ph: 519-823-5600 Fax:519-823-8880 1-800-361-8855	Farm Safety Association, 340 Woodlawn Rd.W Suite 22, Guelph, On N1H 7K6 Email: smatisz@farmsafety.ca
Helmut Spieser Ph:519-674-1618 Fax:519-674-1600	Ridgetown College of Agricultural Technology Ridgetown, On N0P 2C0 Email: hspieser@omafra.gov.on.ca
Neil McLaughlin Ph:613-759-1534 Fax 759 1515	Research Scientist, Eastern Seed & Oilseed Research Centre Agriculture and Agri-Food Canada, 2006 K.W. Neatby Building, 960 Carling Ave., Ottawa, On K1A 0C6 Email: mclaughlinn@en.agr.ca
Finbar Desir Ph:519-826-3549 Fax:519-826-3259	Farm Implements Board OMAFRA, Resources Management Br. 1 Stone Rd W., Guelph, On N1G 4Y2 Email: fdesir@omafra.gov.on.ca
Bill MacGregor Ph:905-734-4501 Fax:905-734-6151	John Deere Welland Works Canal Bank St. Welland, On L3B 3N3 Email: wx20088@deere.com
Innovative Farmers Assoc. Ph:905-729-3254 Fax:905-729-4446	Bob Misener 4760 Haldibrook Rd Caledonia, On N3W 2G8 ph/fx 905-679-3251/6292 email
Ralph Brown Ph: 519-824-4120(3922) Fax:519-836-0227	School of Engineering Univ. of Guelph Guelph, On N1G 2W1 Email: rbbrown@uoguelph.ca
Vacant Ph: 905-841-6888 Fax:905-841-1214	Ontario Retail Farm Equipment Dealers Association,Box 430, 64 Temperance St Aurora, On L4G 3L5
OSCIA Ph: 519-846-5874 Fax:519-846-9378	Paul Vogel ph: 613-528-4045 fax: 1048 RR#1, 3995 Lafleur Rd. Apple Hill, On K0C 1B0 Email: vogelseeds@on.aibn.com.
OCPA Ph:519-837-1660 Fax:519-837-1674	Bill Wagter, Ont Corn Producers Assoc 90 Woodlawn Rd. W Guelph, On N1H 1B2 Email: wagter@linetap.com

FOOD ENGINEERING SUBCOMMITTEE 2001-2002

Name	Organization	Address	phone/fax/email
Peter Ateba	Sandwell Consulting Engineers Ltd.	c/o Andres Wines Ltd. P.O. Box 10550 Winona, Ontario L8E 5S4	Ph: (905) 643-4131 ext 2342 Fax: (905) 643-4481
Belinda Elysee-Collen	St. Lawrence Starch	141 Lakeshore Rd. E. Mississauga Ontario L5G 1E8	Ph: (905) 274-3671, Ext. 276 Fax:Fax: (905)-271-1258Email: belinda_elysee-collen @cargill.com
Dave Delevante	Nacan Products Ltd	201 MacDonald Road Collingwood, Ontario L9Y 4J1	Ph: 705-445-1140 x232 Fax: 705-445-9402 dave.delevante@nstarch.com
Bob Fotheringham	Ontario Bean Producers	140 Raney Cres., London ON N6L 1C3	Ph: (519) 652-3566, Fax: (519) 652-9607 rfother@tcc.on.net
Hugh Fraser	OMAFRA Horticultural Research Institute of Ontario	Vineland Station, Ontario L0R 2E0	Ph: (905) 562-4147, Ext. 304 Fax: (905) 562-5933 hfraser@omafra.gov.on.ca
Frank Holmes	ITA, NRC, Dept. of Food Science	University of Guelph, Guelph, Ont., N1G 2W1	Ph: (519) 824-4120 Ext. 3877 Fax: (905)824-6631 frank.holmes@irap.nrc.ca
Susan Iler (seeking repalcement)	OntarioSoybean Growers Marketing	Board, P.O. Box 1199 Chatham, Ontario N7M 5L8,	Ph: (519) 352-7730 Fax: (519) 352-8983 siler@ciaccess.com
Diana Iwaniw	Sandwell Consulting Engineers	Suite 100, 1016B Sutton Drive, Burlington, Ontario L7L 6B8	Ph: 905-319-1666 Fax: 905-319-1801 Diwaniw@sandwell.com
Ian MacKinnon	Jamesway Incubator Co., Ltd.,	30 High Ridge Court, Cambridge, Ont., N1R 7L3	Ph: 519-624-4646, Fax: 519-624-5803 ianmack@jamesway.com
Allen Mannen	Guelph Food Technology Centre	88 McGilvray St., Guelph, ONTARIO, N1G 2W1	Ph: (519) 821-1246(Ext.5037) Fax: (519) 836-1281 amannen@gftc.ca
Gauri S. Mittal (Past Chair)	School of Engineering,	University of Guelph Guelph, Ontario N1G 2W1	Ph: (519) 824-4120 ext. 2431 Fax: (519) 836-0227 gmittal@uoguelph.ca
Punidadas Piyasena (Chair)	Food Research Program, Agric. & Agric-Food Canada	95 Stone Road West, Box 3650, Guelph, ON N1H 8J7	Ph: (519) 829-2400 Ext. 3147 Fax: (519) 829-2600 piyasenaP@em.agr.ca
Simpson Pao	Dare Foods		Ph: 905-875-1223 Ext 301 Fax: 905-875-2524 Email: apao@darefoods.com
Albert Verbeem	Nestle Foodservices	P.O. Box 1800, Douglas Road, Trenton, Ontario, K8V 5S7	Ph: (613) 394-3328 Ext 274 Fax: (613) 394-4712 al.verbeem@ca.nestle.com
Ivan Vulicevic	Baeckerhaus Veit Ltd	70 Whitmore Road, Woodbridge Ontario, L4L 7Z4	Ph: (905) 850-9229 Ext. 35, Fax (905) 850-9292 Email:ivan@backerhausveit.com
Ping F. Wu	Ansatec	8 Silas Hill Drive, North York, Ontario, M2J 2X9	Ph: (416) 726-6298 Fax (416) 490-6659 Email: pingwu@ansatec.com
	OMAFRA	1 Stone Road West, Guelph, ON N1G 4Y2	Ph: (519) 826-4363 Fax: (519) 826-4375 EMail:ping.wu@omafra.gov.on.ca

MEMBERSHIP FOR 2002 LIVESTOCK ENGINEERING SUB-COMMITTEE

Organization	Name	Contact Information	Term End
OMAFRA	John Johnson, P.Eng. (Chair)	OMAFRA, 667 Exeter Rd. LONDON, ON N6E 1L3 Ph. 519-873-4096 Fax 519-873-4062	Passed due
Univ. of Guelph	Dr. Jan Jofriet, P.Eng.	University of Guelph, School of Engineering, GUELPH, ON NIG 2WI Ph. 519-824-4120 Ext. 3642 Fax 519-836-0227	2002
Private Sector	Jim Cooke, P.Eng.	R.R.#1 Walkerton, ON N0G 2V0 Ph. 519-881-1188 Fax 519-881-3628	2002
Private Sector	Mike Hensen, P.Eng. (invited as guest in 2001)	Soprema Canada 151 York St., Suite 12 London, ON N6A 1A8 Ph. 519-672-5561 Fax 519-672-1578	2005
OMAFRA	Harold House, P.Eng. (invited as guest in 2001)	OMAFRA, Box 159 Don St. Clinton, ON N0M 1L0 Ph. 519-482-1488 Fax 519-482-5031	2005
Shur-Gain Agresearch	Bob Robson	R.R.#3, Burford, ON N0E 1A0 Ph. 519-424-2550 Fax 519-424-2570	2002
Private Sector	Dale Thompson	BSM Farm Equipment	2003
Private Sector	David Waud, (invited as guest in 2002)	Sun North	2005
Private Sector	Ron MacDonald, P.Eng., (invited as guest in 2002)	Agviro Inc.	2005
Private Sector	Ray Jacobs (invited as guest in 2002)	Landmark Builders	2005

Rural Environment Engineering Subcommittee Membership 2001

Jim Myslik, (Chairman) 519-846-0941 519-846-8178(Fax)	Agriculture & Rural Division, OMAFRA, Wellington Place, R. R. # 1, Fergus, Ontario, N1M 2W3
Hugh Whiteley 519-824-4120 519-836-0227(Fax)	School of Engineering, University of Guelph, Guelph, Ontario, N1G 2W1.
Robert Stone 613-475-1630 613-475-3835(Fax)	Agriculture & Rural Division, OMAFRA, Box 8200, Brighton, Ontario, K0K 1H0.
Sid Van der Veen 519-826-3552 519-826-3259(Fax)	Resources and Planning, Branch, OMAFRA, Box 1030, Guelph Agricultural Centre, Guelph, Ontario, N1H 6N1.
Ross Irwin or designate 519-822-3993	Delegate, Land Improvement Contractors of Ontario, 24 Marilyn Dr., Guelph, Ontario, N1H 8E9
Mike McMorris (519) 824-0334 (519) 824-9101 (Fax)	Ontario Cattlemen's Association 130 Malcolm Road Guelph, Ontario, N1K 1B1
Ron Fleming 519-674-1612 519-674-1600(Fax)	University of Guelph - Ridgetown College, Ridgetown, Ontario, N0P 2C0
Sam Bradshaw 416-621-1874(212) 416-621-8720(Fax)	OPPMB, P.O. Box 740, 15 Waulron St., Etobicoke, Ontario, M9C 5H3
Tracy Ryan 519-621-2761(269) 519-621-4844(Fax)	Grand River Conservation Authority, 400 Clyde Rd., Box729, Cambridge, Ont., N1R 5W6

Appendix II : Subcommittee Reports

- ☐ Crops Engineering Research & Services Subcommittee
- ☐ Food Engineering Research & Services Subcommittee
- ☐ Livestock Engineering Research & Services Subcommittee
- ☐ Rural Environment Engineering Research & Services Subcommittee

CROPS ENGINEERING
RESEARCH AND SERVICES SUBCOMMITTEE

2002 REPORT TO

ONTARIO AGRICULTURAL AND FOOD ENGINEERING

RESEARCH AND SERVICES COMMITTEE

TABLE OF CONTENTS

LIST OF ACRONYMS

1.0 EXECUTIVE SUMMARY

2.0 INTRODUCTION

3.0 SUBCOMMITTEE ACTIVITIES

4.0 STATE OF THE INDUSTRY

5.0 ACHIEVEMENTS

6.0 EMERGING ISSUES

7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATION

8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

9.0 DETAILED RECOMMENDATIONS

10.0 APPENDIX

.1 Complete List of Research and Services Needs in Priority listing

.2 Agenda of 2000 meeting

.3 Committee Membership

LIST OF ACRONYMS

OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
ARIO	Agricultural Research Institute of Ontario
U of G	University of Guelph
OATI	Ontario Agricultural Training Institute
OSCIA	Ontario Soil and Crop Improvement Association
RCAT	Ridgetown College of Agricultural Technology
CARC	Canadian Agricultural Research Council
AAFC	Agriculture and Agri-Food Canada
CC	Canada Committees

1.0 EXECUTIVE SUMMARY

The Crops engineering sub-committee prioritised the emerging issues and separated them into research needs and non R&D needs.

RECOMMENDATION I (RESEARCH): RURAL ENERGY ISSUES

In spring of 2002, the Ontario electrical market will be deregulated. There is a need to create a current rural power quality benchmark based on review of past and new fieldwork. This benchmark of power quality would provide away to ensure power quality in the new world after de regulation. There will be large numbers of new small independent generators.

Farmers will have an opportunity to produce some of their own power (stand-by generator, wind power, solar power, micro-hydro,methane , hybrid systems etc.) In light of the electrical market opening up there is a need to determine if low impact energy systems are feasible for rural Ontario.

RECOMMENDATION II (SERVICE)

RURAL ROADS & TRANSPORTING EQUIPMENT SAFETY

Rural road farm and non- farm traffic is increasing. Farming equipment has increase in size, as a respond to the economic pressures to make farming more cost efficient. Cars and trucks are sharing the road with combines and tractors pulling equipment that fill a good portion of the road. Accidents are occurring with these large equipment and cars and trucks. There are a number of safety issues that need to be addressed urgently by the public and private sector. Lack of visibility is a major cause of many accidents.

9. Develop an education and information program to increase visibility of agricultural equipment on public roads in dark or poor lighting conditions.

RECOMMENDATION III (RESEARCH)

Grain and Forage Processing (Drying)

Details:

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment. Ontario corn used in wet milling and for dry-milled food products does not need to be dried to 15% moisture as both industries mill damp grain (i.e., 18-20% wet basis). Also the development of drying systems has not kept pace with the growing industry in conventional and organic production of alternate crops. Producers are forced to adopt a trial-and-error approach to drying or dehydrating, usually with modified tobacco bulk curing kilns or commercial tray dryers.

1. Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment
2. Basic research is required to investigate the requirements of drying phyto-medicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic).
3. Research is needed to design new equipment or modify existing designs to accommodate the new crops
4. Research into Low-temperature Storage of Damp Grain
5. Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.

RECOMMENDATION IV: (RESEARCH)

Solid & Liquid Manure plus bio-solids Applicators Ability to Apply Manure & bio-solids Uniformly on the Land At Desired Rates and odour control.

To develop better application equipment that can apply solid and liquid manure plus bio-solids evenly at target rates specified by a nutrient management plan. All application methods must consider now to reduce odour. This research objective is to reduce the cost of nutrients per unit cost of production, plus reducing the potential of pollution.

1. Acquire information that can be used to fine tune the application rates and control odour.
2. Identify future research needs in the design of solid and liquid manure plus and Bio-solid spreaders.

2.0 INTRODUCTION

This report is the summary of the discussions held by our sub-committee, on Nov 7th, 2001, to discuss and review last year's recommendation and to identify emerging issues in the field of crops engineering. The issues identified were broken down into two categories; those requiring research and development, and those requiring non R&D input. Some requiring non R&D input were to be handled by selected members of the committee within the next year.

3.0 SUBCOMMITTEE ACTIVITIES

During the past year, we have had one meeting of this sub-committee.
At this meeting it was decided to revise recommendations.

4.0 STATE OF THE INDUSTRY

Ontario's agriculture and food industry contributes $25 billion to the provincial economy every year, and employs some 640,000 people. It is Ontario's second largest industry. To remain competitive, farmers must expand and adopt new, more efficient production methods. Some times expanding or new farm operations encounter serious conflict with neighbours.

Farm, rural, environmental and urban groups are studying the issues that put farmers in conflict with their neighbours. In Ontario food production and rural housing in the most part are neighbours. Good neighbours need to trust each other, one way to build trust is by having the agricultural operations do a Nutrient Management Plan.

In the near future there will be a consultation of the rural community with respect to standards for the new provincial Act - Bill 81 (Nutrient Management Act). These standards will help ensure that Ontario has adequate food supply, food safety, environmentally sound farm practices and minimum conflicts.

Machinery companies are starting to target large farms. The machinery companies are positioning them selves to service the fastest-growing segment of the agricultural market that being the large-scale farming operations. For example consider Caterpillar they are producing a new super large rotary combine with a 400 horsepower engine and a 67-inch threshing floor.

There is great debate going on in the States that packers should not own hogs. The message came through loud and clear at the annual meeting of the Iowa Pork Producers Association (IPPA), held in Des Moines. In a member survey, 92% of pork producers in the state said IPPA should continue to lobby against packer ownership of hogs or hog farms. *This debate may come to Ontario in the near future.*
Country of origin labeling for meat was also debated. One resolution passed calling for this labeling on all meat animal protein, including poultry. Another resolution called for the federal government to recognize that any swine in the United States for 90 days or more is considered having originated from the U.S. Why the concern *Iowa's hog farmers feed approximately 1.5 million pigs per year originating from Canada it did not pass.* Country of origin may result in less live weaner pigs being shipped to the states. This would result in more hogs finished in Canada or loss of production if no market?

5.0 ACHIEVEMENTS

Achievements of the Crop Engineering Sub Committee over the past year are listed below.

Hydro pole disconnect switch sizing rules changed by *Ontario Hydro One. Potential savings for farmers have been estimated at $425,000 per thousand farmers who install pole switches.* The *change was based on a research study by* Ontario Ministry of Agriculture, Food and Rural Affairs and Agviro Inc. Funding was from provincial and federal governments in the aftermath of the Eastern Ontario ice storm.

Factsheets/ Infor sheets:

Information Package 2001
HORIZONTAL SILO CAPACITY, by *Steve Clarke, P. Eng. OMAFRA*

Information Package 2001
Hay Bale Weights For, Small Rectangular Hay, Round Bale (for Softcore or Hardcore) Large Rectangular, *by Steve Clarke, P. Eng. OMAFRA*

HARVESTING AND STORING LARGE BALE HAYLAGE, OCTOBER 2001 AGDEX 120/736 Order No. 88-094, S. Clarke P.Eng. OMAFRA

Farm Generators: Making Connections the Safe Way – OMAFRA Factsheet 99-007, April 1999.

Tractor-Driven Generators: Producing Quality Power, A. Hills , B Hawkins, Kemptville College, University of Guelph, Steve Clarke , OMAFRA , Factsheet, order no. 00-059, June 2000, AGDEX 771

Understanding Portable Generators A. Hills , B Hawkins, Kemptville College, University of Guelph, Steve Clarke , OMAFRA, Factsheet ,order no. 00-057, June 2000, AGDEX 771

Standby Electric Generators for Emergency Farm Use, H. Fraser, P.Eng. and J. Johnson, P.Eng. OMAFRA, Factsheet, order no. 99-005, May 1999. AGDEX 771

Canadian Standards Association standard for Farm P.T.O. generators

Farm Vechicles & Equipment and the Highway Traffic Act. MTO Nov. 2000.

Standby Power for Farms:

- *Reference Booklet on Electrical Energy Disaster Planning Manual* and *Materials* for electrical energy disaster plan in the event of extended power outages and energy shortages/delivery problems.
- A Generic Safe *Operating Procedures Manual* (SOP) includes instructions on maintenance as well as operations.
    - A *summary sheet CheckList* that can be attached to the stand-by power system.
- Slide-set for producers wrt energy efficient
- On Farm Standby & Auxiliary Power Systems Hand book
- *Video : Emergency Generators –Safe Use on the Farm*
- *Information CD of On Farm Standby Power*
- Compower Generator computer sizing software

Canadian Standards Association Technical Committee establishing standards for extremity lighting and equipment visibility

- M669-97 (ANSI/ASAE S279.9 Jul93) Lighting and Marketing of Agricultural Field Equipment on Highways
- M673-99 (ANSI/ASAE S338.4 Nov97) Equipment for Agriculture – Safety Chain for Towed Equipment
- M671 – 99 (ASAE S276.5 Nov97) Slow – Moving Vehicle Identification Emblem
- M675-99 (ASAE S365.3 Jul97) Braking System Test Procedures and Braking Performance Criteria for Agricultural Field Equipment

A standard has already been developed for lighting and reflective tape on farm machinery on public roads. It is ASAE S279.11, approved in April 2001. It is presently being ballotted for adoption by the CSA Technical Committee on Agricultural Machinery.

A committee of farmers, small Ontario machinery manufacturers, CSA, the Farm Safety Assn and OMAFRA have presented recommendations to MTO. The recommendations would amend the Highway Traffic Act to incorporate ASAE S279, and to provide for retrofitting of existing farm machinery with appropriate lights and reflective tape.

6.0 EMERGING ISSUES

Terrorist threat:

Pesticide dealers and applicators need to review safety procedures and "be extra vigilant during this time of continued terrorist threat." farmers, aerial applicators, lawn care operators, exterminators and others who regularly store and use pesticides to review management practices Aerial applicators should be especially vigilant about securing equipment and chemicals. Pilots should report any suspicious activity relative to use, training or acquisition of dangerous chemicals or equipment

Value Enhanced Grains (VEG)

Sophisticated markets are developing for agriculture products. Customers are seeking products that better meet their individual needs. Today the end user, be it a processor, livestock producer, or other value adding business is looking for higher quality products or specialized traits that provide an edge in a competitive marketplace. The agricultural system is uniquely equipped to meet these demands as advances in plant composition, agronomics, processing technologies, and infrastructure continue to develop at an ever-quickening pace. *Minimum Segregation begins at the farm*

Value Enhanced Grains fall into one of two categories:

- **Compositional Traits:** Where the grain has been bred or engineered to provide specific characteristics such as high oil, a specific composition of amino acids, a particular level of amylopectin starch; or
- **Management and Handling Traits:** Whereby the grain has been produced and controlled in such a way as to enhance characteristics such as low-stress cracks, organic crops, grain that is free from pesticides, etc.

The demand by grain buyers for these new products is evidenced by the five-fold increase over the past few years in land dedicated just to the production of corn higher in oil content.

In a survey by by American Corn Growers Association over half of the elevators surveyed are requiring segregation of genetically modified (GM) grains from non-GM grains either upon arrival at the elevator or on the farm. Almost 20% reported offering premiums ranging from 5 to 35 cents per bushel for non-GM corn or non-GM soybeans.

Farmers who decide to grow Value Enhanced Grains (VEG) must be ready to segregate harvest and storage of these crops. This will also mean that companies down the food delivery line like processors will have to segregate also.

Canadian government to fast track off-road engine emission standards and for engines with less than 19 kW. The off road sector includes agricultural, construction and forestry equipment, lawn mowers, snowmobiles, ATV's etc. Canada will most likely develop emission standards similar to the U.S.A.

7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS

RESPONSE:

Crops Engineering Subcommittee

Research # II.1.1-B

Solid & Liquid Manure plus bio-solids Applicators Ability to Apply Manure & bio-solids Uniformly on the Land At Desired Rates and Control Odour.

Response:

1. *Agricultural Research Institute of Ontario* - *only provided responses for new recommendations*

AAFC

GPCRC - No activity

SCPFRC - Resources:

SCPFRC has recently initiated a 3-year project in partnership with Ontario Pork, the Agricultural Adaptation Council, and Nuhn industries to investigate swine manure storage and application methods which conserve nutrients, protect the environment from chemical or biological contaminants, and benefit crop yield through suppression of soil-borne diseases.

7.1 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

Recommendation	AAFC	ARIO	CC	CARC	OMAFRA	OTHER
Priority I (Research)						
RURAL ENERGY ISSUES						
To create a bench mark of rural electrical power quality-*[farm or from off-farm power]*	x	x	1,2	x	x	
To determine the feasibilty of Low Impact Renewable energy systems for rural Ontario - [wind, solar, co-generation, small hydro, Methane, Biodiesel etc.]						

Priority II (Research) **Grain and Forage Processing** (Drying) Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment Basic research is required to investigate the requirements of drying phyto-medicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic). Research is needed to design new equipment or modify existing designs to accommodate the new crops Research into Low-temperature Storage of Damp Grain Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.	x	x	1,2	x	x	
Priority III (Research) **Solid & Liquid Manure plus Bio-solids Applicators Ability to Apply Manure & Bio-Solids Uniformly on the Land and control odour.** Acquire information that can be used to determine the application rates. Identify future research needs in the design of solid and liquid manure applicators.	x	x	1,2	x	x	

Canada Committees: 1-Natural Resources 2-Crops 3-Animals 4-Food
FS means Farm Safety And M means Manufacture(s)

9. DETAILED RECOMMENDATION:

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH
AND SERVICES COMMITTEE CROPS ENGINEERING RECOMMENDATION TO:

AGRICULTURE & AGRI-FOOD CANADA,
AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO,
ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS
CANADA COMMITTEES AND CANADIAN AGRICULTURAL RESEARCH COUNCIL

PRIORITY RESEARCH I : RURAL ENERGY ISSUES

In Spring of 2002, the Ontario electrical market will be deregulated. There is a need to create a current rural power quality benchmark based on review of past and new fieldwork. This bench mark of power quality would provide away to ensure power quality in the new world after de regulation. There will be large numbers of new small independent generators.

Farmers will also have an opportunity to produce some of their own power (stand-by generator, wind power, solar power, micro-hydro,methane , hybrid systems etc.) In light of the electrical market opening up there is a need to determine if low impact energy systems are feasible for rural Ontario.

Research is needed

1. **To create a bench mark of rural electrical power quality** *-[farm or from off-farm power]*

2. **To determine the feasibilty of Low Impact Renewable energy systems for rural Ontario** - [wind, solar, co-generation, small hydro, Methane, Biodiesel etc.]

Background:

Co-generation: Farmers will have an opportunity to produce some of their own power (stand-by generator, wind power, solar power, micro-hydro, hybrid systems etc.) will be able to sell that power back to the utility. For large operations, the selling price will likely be based on the wholesale rate but, for smaller operations and residential customers, the utility will simply allow the meter to run backwards (i.e. the customer offsets the retail cost of power).

On Peak "Shaving" or Peak Demand Reduction. Utilities and power re-sellers may offer incentives to their larger customers to reduce power consumption during times of peak demand. A farmer may wish to use a stand-by generator to produce power during peak demand times if the incentive is sufficiently attractive. In considering options of this nature, a full analysis of the cost-benefit of the choices should be conducted. Obviously the cost of producing power through a stand-by generator must be less than the incentive offered but additional considerations such as increased maintenance of stand-by equipment, power quality associated with stand-by generators etc. must be included in the equation.

Power Quality

Sites that have a small independent power source, or one utility transformer that supplies a number of users, such as strip malls and large buildings, are particularly prone to power quality problems. This is because both disturbing and sensitive loads share the same power supply. In addition, the individual loads can represent a very large proportion of the total amount of electricity supplied to the building, so that changes in voltage can be very significant when one of these loads is turned on or off.[Source Canadian Electrical Association National Power Quality Survey,

CEA Report 220D 711 A] In 1991, the Canadian Electrical Association undertook a three-year study of power quality in Canada called the National Power Quality Survey*. Twenty-two utilities across the country performed monitoring for a month at over 500 sites.

The target frequency should be maintained between 58 and 62 Hz. Most equipment is not adversely affected by minor changes in frequency, however, timing devices and clocks which rely on frequency for accuracy will be affected directly with changes in frequency (i.e. 5% high on frequency, clocks run 5% faster and gain 3 minutes/hour).

Cost Benefit:

In the future there will be a growth in small independent power source companies supplying power to farmers and farmers generating there own power. Farmers will have to ensure that the power produced by them or bought from small independent producers meet standards. If power is over or under voltage there can be many problems see table below. These problems will result in motor failure or not starting.

Typical problems associated with high and low voltages for motors are as follows:

Low Voltage	**High Voltage**
Motor will not start load	High starting current
Motor Stalls	Motor overload protection trips
Motor overload protection trips	Motor overheats
Motor overheats	

Power quality disturbances are deviations from the specified voltage and frequency delivered by the utility that can cause problems with sensitive electrical and electronic equipment. Problems experienced include loss of computer data, malfunctioning electronic equipment, flickering, dimming or brightening of lights, increased need for equipment servicing or decreased life of electronic equipment, overheated equipment, blown fuses and overheated or tripped breakers and fuses. Koval et al[1] indicated, in their case study of two Alberta farms, that the source of the power quality deviation may come from the farm or from off-farm. In their cases, the on-farm source resulted in under- voltage sags whereas the off-farm sources caused over-voltage surges. Voltage sags and surges were registered only if the value fell out side the normal operating tolerances of 108 and 125 volts (as specified in CSA standard CAN3-C235-83)

If a transient occurs on the electrical distribution system and it falls outside of the Acceptable Voltage Tolerance Envelope then a "soft failure" or malfunction of electrical equipment such as a computer "lock up" or equipment resetting, or "hard failure" causing permanent damage (burn out) may occur.

2. **To determine the feasibilty of Low Impact Renewable energy systems for rural Ontario** - [wind, solar, co-generation, small hydro, Methane, Biodiesel etc.]

Background/ Cost benefit:

Currently many sectors of the economy are concerned about energy supply, security and stable long-term prices. Low impact energy system would deliver secure supplies, and long term fixed costs.

Promoting low impact energy would help Canada to meet its Kyoto Protocol of reduced green house gas [GHG] emissions. Some reports indicate that Canada could reduce GHG emissions by 5 to 10 percent if low impact energy systems were promoted.

Promotion of low impact energy systems would stimulate the economy, create new high tech employment, and help Canada meet its Kyoto GHG commitment.

9. DETAILED RECOMMENDATION:

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH
AND SERVICES COMMITTEE CROPS ENGINEERING RECOMMENDATION TO:

AGRICULTURE & AGRI-FOOD CANADA,
AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO,
ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS
CANADA COMMITTEES AND CANADIAN AGRICULTURAL RESEARCH COUNCIL

PRIORITY RESEARCH II

GRAIN and FORAGE PROCESSING (Drying)

Details:

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment. Ontario corn used in wet milling and for dry-milled food products does not need to be dried to 15% moisture as both industries mill damp grain (i.e., 18-20% wet basis). Also the development of drying systems has not kept pace with the growing industry in conventional and organic production of alternate crops. Producers are forced to adopt a trial-and-error approach to drying or dehydrating, usually with modified tobacco bulk curing kilns or commercial tray dryers.

- Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment
- Basic research is required to investigate the requirements of drying phyto-medicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic).
- Research is needed to design new equipment or modify existing designs to accommodate the new crops
- Research into Low-temperature Storage of Damp Grain
- Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.

Background:

The food grade corn industry in Ontario could potentially expand from its present level of about 2 million bushels up to 20 million bushels or more annually if we develop the varieties and the production system to assure delivery of consistent quality. With the pending release of white and food-grade yellow corn varieties for Ontario conditions, there should be an increased export opportunity for snack food corn products. Brian Doidge has estimated that the potential for expansion may be up to $55 million annually (Source - *Food Grade Corn: Expanding the Industry in Ontario*, a report published by Ridgetown College, University of Guelph, July, 1997). Ontario corn would find wider acceptance in local and global industrial markets if it was assured free of physical and chemical damage.

Cost \ Benefits

In about one out of four or five years, poor harvest conditions necessitate drying regimes that cause unacceptable damage, and this is often not visibly apparent to the buyer. Consequently some industrial buyers prefer to import American corn rather than buy locally. Advanced dryer controls and drying systems would save an estimated $6-8 million annually through only the reduction of fuel energy used to over dry corn, and the minimization of hidden losses in storage and handling.

Resources:

The School of Engineering at the University of Guelph maintains ongoing research in crop drying and storage technology (Drs. R. Brown and L. Otten). Current projects involve aeration and cold-temperature damp corn storage, low-temperature drying control systems and drying guidelines for food-grade corn. At the Ridgetown College campus Helmut Spieser is active in extension of grain drying technology and some research activity. Dr. Judith Fregeau-Reid at ECORC in Ottawa works in the area of corn quality as it relates to milling requirements and also evaluation screening of corn varieties.

9. DETAILED RECOMMENDATION:

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH
AND SERVICES COMMITTEECROPS ENGINEERINGRECOMMENDATION TO:

AGRICULTURE & AGRI-FOOD CANADA,
AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO,
ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS
CANADA COMMITTEES AND CANADIAN AGRICULTURAL RESEARCH COUNCIL

PRIORITY RESEARCH III

Solid & Liquid Manure plus bio-solids Applicators Ability to Apply Manure & bio-solids Uniformly on the Land At Desired Rates and Control Odour.

DETAILS:

To develop better application equipment that can apply solid, and liquid manure plus bio-solids evenly at target rates specified by a nutrient management plan. All application methods must consider now to reduce odour. This research objective is to reduce the cost of nutrients per unit cost of production, plus reducing the potential of pollution and rural conflict.

1. Acquire information that can be used to fine tune the application rates and odour control.
2. Identify future research needs in the design of solid and liquid manure plus bio-solid spreaders.

BACKGROUND and COST/BENEFITS

If farmers do not voluntarily handle their manure properly then rules may be required to force farmers to do so. Good quality manure application equipment will encourage the farmer to use the manure as a valued nutrient reducing off-farm fertilizer purchases (making the farm more competitive) and reducing environmental losses (making the farm more environmentally acceptable). A "win/win" situation.

In Ontario, an estimated 37 million tons of manure is applied to the land base. This manure 156,000 tons of nitrogen, 79,000 tons of phosphate and 162,000 tons of potash. If fully used to replace commercial fertilizer, it would have a 1995 value of 200 million dollars. Conversely, if not treated properly it could have a negative value as a pollution source. Preliminary research has shown that existing manure application equipment is very difficult to calibrate and does not apply manure evenly across the desired application band.

If better equipment can be developed, farmers will have greater confidence that manure is applied to target areas and they will reduce commercial fertilizer use. This will improve the profitability of the farm and reduce the over application of nutrients lowering possible adverse effects on the environment.

Finally, Ontario is a major manufacturer of manure application equipment. If Ontario develops better technology it is expected that the global demand for our technology will increase. This has the potential for an increase of manufacturing jobs in this field.

Resources

OMAFRA's Engineering and Soil and Crop Specialists are currently working on preliminary projects to develop better equipment.

Husky Farm Equipment, John Deere Welland Works, Agri-Food Labs, Ag Can and OMAFRA have initiated a 4 year MII project to develop precision manure application equipment. See Appendix for update on this project.

9. DETAILED RECOMMENDATION:

PRIORITY SERVICE 1

RURAL ROADS & TRANSPORTING EQUIPMENT SAFETY

Rural road farm and non- farm traffic is increasing. Farm equipment has increased in size, as a respond to the economic pressures to make farming more cost efficient. Farms are larger than in the past, so operators are forced to travel greater distances on the roadways between fields. Cars and trucks are sharing the road with combines and tractors pulling equipment that fill a good portion of the road. Accidents are occurring with these large equipment and cars and trucks. There are a number of safety issues that need to be addressed urgently by the public and private sector.

Background:

There were over 2,500 farm-related highway accidents in which 842 persons were injured and 33 killed in the last five years according to the Ohio Department of Highway Safety. In Ontario accidents involving tractors in 1992 were 165 accidents 2 deaths, 39 personal injuries and 124-property damage. There are no stats on just farm equipment accidents. Lack of visibility is a major cause of many accidents.

Details:

1. Develop an education and information program to increase visibility of agricultural equipment on public roads in dark or poor lighting conditions.

2. Develop an awareness program on the moving of large farm equipment for non farmers and farmers

3. Develop standards for the use of lights or reflective tape (similar to type on transport trucks) on farm machinery on public roads for front and rear viewing of other road traffic in low and no-light conditions.

APPENDIX

10.1 2001 COMPLETE LIST OF CROPS ENGINEERING RESEARCH AND SERVICES NEEDS:

RECOMMENDATION 1 (Research)

RURAL ENERGY ISSUES

In Spring of 2002, the Ontario electrical market will be deregulated. There is a need to create a current rural power quality benchmark based on review of past and new fieldwork. This bench mark of power quality would provide away to ensure power quality in the new world after de regulation. There will be large numbers of new small independent generators.
Farmers will also have an opportunity to produce some of their own power (stand-by generator, wind power, solar power, micro-hydro,methane , hybrid systems etc.) In light of the electrical market opening up there is a need to determine if alternative power systems are feasible for rural Ontario.

Research is needed

1. To develop a bench mark of Rural electrical power quality *-[farm or from off-farm power]*

2. To determine the feasibilty of alternative power systems for rural Ontario - *[wind, solar, co-generation, small hydro, Methane etc.]*

RECOMMENDATION 2 (Service):

RURAL ROADS & TRANSPORTING EQUIPMENT SAFETY

Rural road farm and non-farm traffic is increasing. Farming equipment has ***increased*** in size, as a ***response*** to the economic pressures to make farming more cost efficient. Cars and trucks are sharing the road with combines and tractors pulling equipment that fill a good portion of the road. Accidents are occurring with these large equipment and cars and trucks. There are a number of safety issues that need to be addressed urgently by the public and private sector. ***Poor*** visibility ***and lack of awareness of the size of road space required by farm machinery are major causes*** of many accidents.

1 Develop an education and information program to increase visibility of agricultural equipment on public roads in dark or poor lighting conditions.

RECOMMENDATION 3 (Research) :

Grain and Forage Processing (Drying)

Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment. Ontario corn used in wet milling and for dry-milled food products does not need to be dried to 15% moisture as both industries mill damp grain (i.e., 18-20% wet basis). Also the development of drying systems has not kept pace with the growing industry in conventional and organic production of alternate crops. Producers are forced to adopt a trial-and-error approach to drying or dehydrating, usually with modified tobacco bulk curing kilns or commercial tray dryers.

- Research is needed in new technology for drying equipment suitable for food grade corn drying, and control systems for regulating that equipment

- Basic research is required to investigate the requirements of drying phyto-medicinals, nutraceuticals and horticultural herbage and root crops (e.g., ginseng, echinacea, garlic).

- Research is needed to design new equipment or modify existing designs to accommodate the new crops

- Research into Low-temperature Storage of Damp Grain

Designs to reduce cost and energy consumption, while maintaining crop quality during the drying process.

RECOMMENDATION 4 (Research)

Solid & Liquid Manure plus Bio-solids Applicators Ability to Apply Material Uniformly on the Land At Desired Rates and Odour Control

To investigate the ability of solid and liquid manure plus bio-solids applicators to spread manure and bio-solids in a uniform coating on the land and with minimum odour. Thereby improving the overall efficiency of nutrient application. This research objective is to reduce the cost of nutrients per unit cost of production, plus reducing the potential of pollution and reduce rural conflict.

Farmers are being encouraged to develop nutrient management plans for their farms and be good neighbours. To do this they need application equipment that will apply manure and bio-solids evenly and at the desired rates and at minimum odour. This is the goal of this research.

1. Acquire information that can be used to determine the application rates and odour control.

2. Identify future research needs in the design of solid and liquid manure applicators.

RECOMMENDATION 5 (Service):

NON COMPACTING FIELD EQUIPMENT

As farm operation have increased in size, farm equipment, combines and tractors have become larger and heavier. Manure spreaders can weigh as much as 14 tons and tractors 20 tons. Soil compaction stunts plant growth causing yield decreases of approximately 20 percent. There has been lots of work done on reducing tractor pressure loads by using dual, radial tires and four-wheel drive. Current management of large tractors can in most cases reduce pressure loads to 6-to10 psi on the ground.

Work is needed to reduce soil pressure caused by farm equipment. Currently tire soil pressures can be quite high for large liquid manure spreaders (48 psi) , Combines, rear 10 - 32 psi & front 22 to 37 psi. and grain buggies (48 psi,

1. Research is needed to design new equipment or modify existing designs to reduce soil pressures for, manure and fertilizer spreaders, combines, grain buggies, etc.

RECOMMENDATION 6 (Research)

No-TILL SYSTEMS

No-till is fast becoming an accepted farming system. Basic and applied information is required to deal with no till and nutrient management issues.

RECOMMENDATION 7 (Research)

Site-specific Crop Management

Basic and applied information is required to sustain the precision farming movement. Information is needed to assess for the use of differential global positioning systems data, from yield monitors and crop sensors for site-specific crop management. (not hardware development).

Site-specific Crop Management

Research is needed:

1. Determining the right Interpretation of combine yield maps in terms of subsequent crop nutrient management.

2. Application of GPS-guided application technology and GIS mapping for spatially-variable input rates needs to be developed.

3. Long-term research & assessment of the yield effects and sustainability of variable input agriculture is necessary.

RECOMMENDATION 8 (Service):

Pest Control

1. To demonstrate alternative Pest Control Measures, which may include; propane flamer, plastic-lined interception ditches, electrical discharge weed control, hot water vegetation control and mechanical pest removal, etc.

2. Information on these alternative pest control measures needs to be available so producers can effectively evaluate its potential in his system. This technology transfer could include; in field demonstrations, producer workshops, educational videotapes, and factsheets.

Service/Training is needed on:

(a) Performance of alternative pest control measures.
(b) Limitations of effectiveness of alternative control measures.
(c) Understanding the development of the pest and susceptible periods.
(d) Importance of proper environmental conditions for optimum pest control.

RECOMMENDATION 9: (Service)

SOFT-WARE, MACHINERY MANAGEMENT

There is very little current work in this area. More farmer friendly agricultural computer soft-ware is needed that can run on personal computers.

RECOMMENDATION 10: (Research)

Off Road Emissions

With California introducing emissions standards for diesel engines in January 1986, it will only be a matter of time before standards are demanded for Ontario. Now is the time for industry and government to get involved so that the standards will reflect Ontario Conditions. Research is needed to help in development of these emission standards. Ontario has automobile emission testing program. The question is will there also be one for off road equipment?

RECOMMENDATION 11: (Service)

Technology Transfer

There are a number of topics where little information is available to the consumers with respect to farm machinery, which have been identified by the committee members.

1. Growing concern with respect to compaction and the effect of deep versus shallow compaction especially for fine textured soils.

2. Markers for Sprayers Information in the form of a factsheet describing some of the technical aspects of the markers which also points out the benefits of this device would be useful.

10.1 Complete list of Research and Services Needs in a Priority Listing

RESEARCH & SERVICE RECOMMENDATIONS

2002

RECOMMENDATION	
1	(RESEARCH) RURAL ENERGY ISSUES
2	(SERVICE) RURAL ROADS & TRANSPORTING EQUIPMENT SAFETY
3	(RESEARCH) GRAIN / FORAGE PROCESSING
4	(RESEARCH) MANURE & BIO SOLID APPLICATION/ODOUR CONTROL
5	(SERVICE) NON COMPACTING FIELD EQUIPMENT
6	(RESEARCH) MIMIMUM TILL SYSTEMS
7	(RESEARCH) SITE SPECIFIC MANAGEMENT
8	(SERVICE) PEST CONTROL
9	(SERVICE) SOFTWARE MACHINERY MANAGEMENT
10	(RESEARCH) OFF ROAD EMISSIONS
11	(SERVICE) TECHNOLOGY TRANSFER

10.2 MEMORANDUM TO: Members of the Crops Engineering Research and Services Subcommittee of the O.A.E.R.S.C.

Subject: AGENDA of half day meeting to be held
Wednesday Nov 7th 2001 at 2:00 PM to 5:00

The next meeting of the Crops Engineering Research and Services Subcommittee of the OAERSC will take place at *OMAFRA Head office Guelph, Ontario. Corner of Stone and Gordon. In board room 406 on the four floor.*

Please come with a list of emerging issues, problems or concerns that you have, or the organization that you represent have, with respect to agricultural machinery, crop storage and equipment industry.

I know that some of you will not be able to attend given the short notice. If you can not attend, please send the above information by fax to me by Nov 5 or 6th. I will be in Guelph Tues, Wed Nov 6,7, however I will check my office for fax comments. Thank you.

AGENDA

2:00 pm Introduction

2:05-2:45 Discussion

1. New problems, issues or topics requiring research in the crops engineering area.

2. Identify service programs relative to crops engineering and consider recommendations on the needs for service, and ways to improve present programs and our need for new programs.

3. Review and summarize items 1 and 2 for input into report. (Chairman and secretary to write final copy).

2:35 – 3:15 Review The Ranking of Research and Service items for Enclosure in the 1999 Report

3:30 – 4:00 Wrap up and action plans

NOTE: Please get in touch with me if you are unable to attend.

Stephen Clarke, P.Eng. Chairperson

OMAFRA, Box 2004,Kemptville, Ont.K0G 1J0.
Telephone: 613/258-8305 or Fax: 613/258-8392.email: sclarke@omafra.gov.on.ca
Local contact: Kathie Noble, Administrative Service Representative
Phone: 519-826-3132. Fax: 519-826-3259 kathie.noble@omafra.gov.on.ca

10.3 Crops Engineering Committee Membership 2002

Steve Clarke Ont. Min. Agr. Food & Rural Affairs
Chairperson ORC Building, Box 2004
Ph: 613-258-8305 Kemptville, On K0G 1J0
Fax: 613-258-8392 Email: sclarke@omafra.gov.on.ca

Ben Hawkins Kemptville College, University of Guelph
Ph: 613-258-8458 .... Assoc. Director, Box 2004
Fax:613-258-8384 Kemptville, On K0G 1J0 Email: bhawkins@kemptvillec.uofguelph.ca

Steve Matisz Farm Safety Association, 340 Woodlawn Rd.W
Ph: 519-823-5600 Suite 22, Guelph, On N1H 7K6
Fax:519-823-8880 Email: smatisz@farmsafety.ca
1-800-361-8855

Helmut Spieser Ridgetown College of Agricultural Technology
Ph:519-674-1618 Ridgetown, On N0P 2C0
Fax:519-674-1600 Email: hspieser@omafra.gov.on.ca

Neil McLaughlin Research Scientist, Eastern Seed & Oilseed Research Centre
Ph:613-759-1534 Agriculture and Agri-Food Canada,
Fax 759 1515 2006 K.W. Neatby Building, 960 Carling Ave., Ottawa, On K1A 0C6
Email: mclaughlinn@en.agr.ca

Finbar Desir Farm Implements Board
Ph:519-826-3549 OMAFRA, Resources Management Br.
Fax:519-826-3259 1 Stone Rd W., Guelph, On N1G 4Y2 Email: fdesir@omafra.gov.on.ca

Bill MacGregor John Deere Welland Works
Ph:905-734-4501 Canal Bank St.
Fax:905-734-6151 Welland, On L3B 3N3 Email: wx20088@deere.com

Innovative Farmers Bob Misener
Assoc. 4760 Haldibrook Rd
Ph:905-729-3254 Caledonia, On N3W 2G8
Fax:905-729-4446 ph/fx 905-679-3251/6292 email

Ralph Brown School of Engineering
Ph: 519-824-4120(3922)Univ. of Guelph
Fax:519-836-0227 Guelph, On N1G 2W1 Email: rbbrown@uoguelph.ca

Vacant Ontario Retail Farm Equipment
Ph: 905-841-6888 Dealers Association,Box 430, 64 Temperance St
Fax:905-841-1214 Aurora, On L4G 3L5

OSCIA Paul Vogel ph: 613-528-4045 fax: 1048
Ph: 519-846-5874 RR#1, 3995 Lafleur Rd.
Fax:519-846-9378 Apple Hill, On K0C 1B0 Email: vogelseeds@on.aibn.com.

OCPA Bill Wagter, Ont Corn Producers Assoc
Ph:519-837-1660 90 Woodlawn Rd. W
Fax:519-837-1674 Guelph, On N1H 1B2 Email: wagter@linetap.com

FOOD ENGINEERING SUBCOMMITTEE

2001 ANNUAL REPORT

TO

ONTARIO AGRICULTURAL AND FOOD

ENGINEERING RESEARCH AND SERVICES

COMMITTEE

October 2001

TABLE OF CONTENTS

PAGE

LIST OF ACRONYMS

1.0 EXECUTIVE SUMMARY 1

2.0 INTRODUCTION 2

3.0 MISSION or MANDATE 2

4.0 INDUSTRY/SECTOR SCAN 2

5.0 REPORT OF ACTION TAKEN ON PREVIOUS RECOMMENDATIONS 11

6.0 STRATEGIC DIRECTIONS/PROBLEMS or ISSUES/SECTOR PRIORITY 15

7.0 DETAILED RECOMMENDATIONS 19

8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS 35

FOOD ENGINEERING SUB-COMMITTEE 2000-2001 37

FOOD ENGINEERING SUB-COMMITTEE 2001-2002 39

LIST OF ACRONYMS

AAFC	Agriculture and Agri-Food Canada
ARIO	Agriculture Research Institute of Ontario
CARC	Canadian Agricultural Research Council
CCF	Canada Committee on Food
CFIA	Canadian Food Inspection Agency
CRIFS	Canadian Research Institute for Food Safety
GDP	Gross Domestic Product
GFTC	Guelph Food Technology Centre
HACCP	Hazard Analysis and Critical Control Points
MMO	Materials and Manufacturing Ontario
NRC	National Research Council Canada
NSERC	Natural Sciences and Engineering Research Council
OAFERSC	Ontario Agriculture and Food Engineering Research and Services Committee
OASCC	Ontario Agricultural Services Coordinating Committee
OFPRF	Ontario Food Processing Research Fund
OFRSC	Ontario Food Processing Research and Services Committee
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
SOE	School of Engineering
TQM	Total Quality Management
UOG	University of Guelph

1.0 EXECUTIVE SUMMARY

The Food Engineering Subcommittee presents this report to the Ontario Agriculture and Food Engineering Research and Services Committee (OAFERSC). The need to be competitive in the World marketplace remains the number one challenge facing the food manufacturing sector in Ontario. In reviewing the actions that would benefit Ontario food processors, the Food Engineering Subcommittee has decided to place the highest priority on the following research and service recommendations.

RESEARCH PRIORITIES

1. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life. Baking and frying processes modelling to improve baked and fried products' quality.

2. Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans. In-line sensors for microbial detection, moisture measurement at high temperature for baked foods and dough properties are required.

3. Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods.

4. By product utilization and waste management

5. Raw material characterization for food product quality.

6. Optimizing material handling in wine and beer industry.

7. Process development for new products for small processors

8. New material to replace stainless steel and to use in new processes

SERVICE PRIORITIES

1. Providing induction training and continuing education/training for employees in food processing sector, producing more qualified food engineering graduates and trade personnel, and the recognition of food engineering professions.

2. Setting up water quality standards for different products (beer, wine, meats, etc.) and standardized odour measurement method

3. Stream lined and harmonized food inspection regulations at all three levels of government (federal, provincial and municipal).

4. Support for HACCP set up, and provide funding for small processors to upgrade the processing equipment.
5. Regulations for reusable containers in the meat industry.

6. Developing a stream lined universal research proposal application form and evaluation process by the funding agencies and institutions.

2.0 INTRODUCTION

This is the 2001 report of the Food Engineering Subcommittee to OAFERSC. Food engineering is a specialized discipline within the engineering profession and food engineering research and service are necessary supports to the Ontario food processing industry. In addition to reviewing these areas within the Food Engineering Subcommittee, food engineers serve on other committees and subcommittees within the OASCC committee structure. The Food Engineering Subcommittee recognises the importance of maintaining closer interactions with the Ontario Food Research and Services Committee (OFRSC) as well as the Expert committees on Food Engineering and Refrigeration at the national level.

The Food Engineering Subcommittee has representatives from producers' boards, private sector, OMAFRA, University of Guelph, Agri. & Agri.-Food Canada and the National Research Council (NRC).

3.0 MISSION or MANDATE

Concerns itself with the research and services regarding technology, processes and equipment related to the production side of the food processing. This is in contrast to the Food Science concerns which are food product related. There is of course, a great deal of interdependent, interaction between these engineering and science disciplines.

4.0 INDUSTRY/SECTOR SCAN

4.1 Major accomplishments since last report

(a) Mr. Hugh W. Fraser (OMAFRA) spent about 20% of his time dealing with production engineering issues affecting the horticultural industry, including: rapid cooling options for produce; short and long-term storage; and shipping container options. He also spends increasing time on environmental issues affecting the horticultural industry including; disposal of plastic sheeting materials; handling and storage of washwaters and culled produce; nutrient management for manure; and noise abatement on a variety of topics.

(b)Modeling alkaline phosphatase inactivation in bovine milk during high-temperature short-time pasteurization was done to developed an inactivation model for this enzyme in milk. Absence of this enzyme is used as the indicator for successful pasteurization of milk by the inspecting agencies. (Q. Lu1, P. Piyasena2, and G.S. Mittal1) 1UOG, 2 AAFC

(c) Reduction in levels of Escherichia coli O157:H7 in apple cider by Pulsed Electric Fields was tested using this non thermal process method. (Janet Iu, Gauri S. Mittal and Mansel W. Griffiths, UOG)

(d) Artificial neural network for the prediction of temperature, moisture and fat contents in meatballs during deep-fat frying was developed. (G.S. Mittal & J. Zhang, UOG)

(e) Use of Artificial Neural Network to Predict Temperature, Moisture and Fat in Slab -Shaped Foods with Edible Coatings during Deep-Fat Frying was investigated. (G.S. MITTAL and J. ZHANG, UOG)

(f) Dr. V. Davidson's (SOE) research focuses on computer-based process control and decision-support in food processing. Funding for this research was obtained from the NSERC. The current area of application is quality-based drying of ginseng roots using image analysis. The bakery project supported by Materials and Manufacturing Ontario (MMO) in collaboration with Nabisco Brands finished in March.

(g) Dr. Davidson is a member of a Quantitative Risk Assessment group which includes researchers from the University of Guelph, Brock University, Health Canada, AAFC and OMAFRA. The group was successful in obtaining funding for a three-year Strategic Grant (NSERC) "Microbial Food Safety – Integrated Modelling Techniques for Farm-to-fork Risk Assessment". This work complements Dr. Davidson's research supported by the OMAFRA Foods program ("Fuzzy and Statistical Techniques for Food Safety Risk Characterization & Valuation").

(h) Dr. Piyasena (FRP, AAFC) is a member of the Executive committee of CRIFS that had submitted a proposal to Canadian Foundation for innovations for the amount of $6.5M. If successful, closer to $2.0M will be used to buy equipment to set up a nonthermal processing facility that would be unique in Canada.

(J) Dr. Piyasena Investigated the dielectric properties of food components (salt, sugar, mailc acid, starch, guar) as a function of temperature and frequency. Results indicated that these properties are influenced by temperature and the food components. These results will be used in developing a radio frequency based heating process for pasteurization of viscous and heat sensitive liquid food products.

Methods for the measurement of polyphenoloxidase (PPO) in apple cider and lettuce were developed. These methods will be used in measuring the inactivation PPO in apple cider and to study the kinetics of browning of Ready-to-Use lettuce.

Modified and further developed a user friendly Pasteurization software in Visual C++ to calculate the microbial inactivation during different thermal process conditions in different equipment (HTST, RF etc.), operational conditions, and configuration. This was originally developed by Dr. McKellar in Visual Basic.

Dr. Piyasena continued to study the inactivation of Escherichia coli O157:H7, Pediococcus sp. and polyphenoloxidase during high-temperature short-time pasteurization of cider in order to find the safe pasteurization temperature-time combinations.

(h)Dr. S. X. Yang's (SOE) research is to model the lycopene extraction from tomato in supercritical CO_2 fluid extraction by conventional and soft computing approaches. This research funded by OMAFRA includes modeling and analysis of supercritical fluid extraction using both conventional, soft computing, and hybrid approaches. The relationship between the extraction yield rate with temperate and pressure is studied using various modeling approach, including classic Peng-Robinson (PR) model, fast backpropagation neural network (NN) model, radius basis function (RBF) network model, and hybrid NN-PR model. Optimization of extraction parameters of supercritical fluid extraction technology is carried out using genetic algorithms.

Publications

(a) Peer-reviewed journal publications

Brown, R.B., T.R. Rothwell and V.J. Davidson 2001. A fuzzy controller for infrared roasting of a cereal grain. Can. Biosys. Engineer. 43(3):9-15.

Davidson, V.J., Ryks, J. and T. Chu 2001. Fuzzy Models to Predict Consumer Ratings for Biscuits Based on Digital Image Features. IEEE Trans. Fuzzy Sys. 9(1):53-61.

Mittal, G.S. and Zhang, J. 2000. Prediction of sodium ion concentration in frankfurters during smokehouse cooking using neural network. Italian J. Food Sci.12:469-476.

Mittal, G.S. and Zhang, J. 2000. Prediction of temperature, and moisture and fat contents in slab-shaped foods coated with edible films during deep-fat frying using artificial neural network. J. Food Sci. 65:978-983.

Ho, S. and Mittal, G.S. 2000. High voltage pulsed electrical field liquid food pasteurization. Food Rev. Int. 16(4):395-434.

Albert, S. and G.S. Mittal. 2001. Comparative evaluation of edible coatings to reduce fat uptake in deep-fried foods. Food Research Int. (accepted 2001 07 16)

Ho, S.Y. and G.S. Mittal. 2001. Non-thermal inactivation in waste brine using high-voltage low-energy electrical pulses. Innovative Food Sci. & Emerging Technologies (2000 06 20)

Lu, Q., P. Piyasena and G.S. Mittal. 2001. Alkaline phosphatase inactivation in bovine milk during high-temperature short-time pasteurization. Food Sci. and Technol. Int. (2001 06 20)

Dumas, C. and Mittal, G.S. 2001. Pizza baking – modelling and simulation. Int. J. Food Properties (2001 06 29)

Iu, J., G.S. Mittal and M.W. Griffiths. 2001. Reduction in levels of *Escherichia coli O157:H7* in apple cider by Pulsed Electric Fields. Journal of Food Protection 64: 964 -969.

Mittal, G.S. and Zhang, J. 2001. Artificial neural network for the prediction of temperature, and moisture and fat contents in meatballs during deep-fat frying. Int. J. Food Sci. Technol. 36:1-9.

Yang, S. X., Shi, J. and Li, H. (In press) Modeling of supercritical fluid extraction by neural networks. Intelligent Automation and Soft Computing.

(b) Refereed Conference Proceedings

Yuan, G., Yang, S.X. and Mittal, G.S. 2001. Tracking control of a mobile robot using a neuraldynamics based approach. Proc. of the 2001 IEEE Int. Conf. On Robotics & Automation, Seoul, Korea, 163-168.

Yang, S.X., Yuan, G., Meng, M. and Mittal, G.S. 2001. Real-time collision-free path planning and tracking control of a nonholonomic mobile robot using a biologically inspired approach. Proc. of the 2001 IEEE Int. Conf. On Robotics & Automation, Seoul, Korea, 3402-3407.

(c)Conference Presentations

Baik, O. and Mittal, G.S. 2001. Food process modelling and simulation for food safety and quality. CSAE-NABEC Conf., Guelph, Paper #01-306.

Davidson, V.J., X. Li and R.B. Brown 2001 Quality Preservation during Ginseng Drying. Annual AIChE Meeting, Conference on Food Engineering, Nov. 4-9, Reno NV.

Zhang, J. and Mittal, G.S. 2001. Artificial neural network applications in food process design. CSAE-NABEC Conf., Guelph, Paper #01-300.

Ho, S. and Mittal, G.S. 2001. Nonthermal pasteurization of pumpable foods using low-energy pulsed electrical field. CSAE-NABEC Conf., Guelph, Paper #01-308.

Wu, Y., Mittal, G.S., Zhang, J. and Griffiths, M.W. 2001. Inactivation effects of pulsed electric field (PEF) on microorganisms in red grape juice. CSAE-NABEC Conf., Guelph, Paper #01-313.

Baik, O. and Mittal, G.S. 2001. Modelling thermal properties of tofu during cooking. CSAE-NABEC Conf., Guelph, Paper #01-323.

Lu, Q., Piyasena, P. and Mittal, G.S. 2001. Determination of activation energy of alkaline phosphatase and its inactivation in bovine milk during high-temperature short-time pasteurizaion using a small scale pasteurizer. CSAE-NABEC Conf., Guelph, Paper #01-324.

Awuah, G.B., H.S. Ramaswamy (FSAC, McGills), P. Piyasena, C. Defelice (FRP, AAFC). Radio frequency heating of viscous foods. Journée d'information scientifique et technique en génie agroalimentaire, La Société canadienne de génie agroalimentaire, et biologique, Le mercredi 21 mars 2001, Centre de Recherche et de Développement sur les Aliments (CRDA) Saint-Hyacinthe.

Awuah, G.W., (FSAC, McGills), P. Piyasena, (FRP, AAFC), C. Defelice, H. S. Ramaswamy. Dielectric properties of starch solutions in the RF range (10 to 30 MHz). IFT Annual Meeting : (June 23-27, 2001, New Orleans, LA)

Awuah, G. B., H. S.Ramaswamy,(FSAC, McGills), P. Piyasena (FRP, AAFC). Radio frequency (RF) heating of starch solutions as influenced by system and product parameters at 27.12 MHz. IFT Annual Meeting : (June 23-27, 2001, New Orleans, LA)

Piyasena, P., and C. Dussault (FRP, AAFC). Evaluation of a 1.5 kW radio-frequency heater for its potential use in a High Temperature Short Time (HTST) process. CSAE-NABEC Conf., July 8-11, 2001. Guelph, ON and Food Network 2001 (June 7-8, 2001, FRP, AAFC, Guelph, ON)

Piyasena. P. Radio Frequency Heating for food Processing, CSAE-NABEC Conf., July 8-11, 2001. Guelph, ON

Pisysena, P., and A.-C. Loquin (FRP, AAFC). Inactivation of polyphenol oxidase in apple cider during High-Temperature Short-time Pasteurization using a small scale pasteurizer. Food Network 2001 (June 7-8, 2001, FRP, AAFC, Guelph, ON)

Li Wan Po, J.-M. (UOG), P. Piyasena (FRP, AAFC), F. M. Bartlett, R.C. McKellar, G. Mittal, and X. Lu. Determination of D and Z-values for *Escherichia coli O157:H7* in simulated apple cider. Food Network 2001 (June 7-8, 2001, FRP, AAFC, Guelph, ON) and Outdoor Farm show, Woodstock, ON, Sept. 11-13, 2001.

Piyasena, P. and C. Defelice. (FRP, AAFC). The influence of temperature and frequency on dielectric properties of 1% salt, sugar and malic acid solutions in the RF range (1 to 30 MHz) Food Network 2001 (June 7-8, 2001, FRP, AAFC, Guelph, ON)

Piyasena, P., M. Rayner, F. M. Bartlett, and R. C. McKellar (FRP, AAFC). Characterization of apples and apple cider produced by a Guelph area orchard. Food Network 2001 (June 7-8, 2001, FRP, AAFC, Guelph, ON)

Ramaswamy, H. S., G. Awuah, FSAC, McGills), P. Piyasena (FRP, AAFC). Dimensionless Correlations for Radio Frequency Heating of Starch Solutions. Thermal Processing of Food, Conference of Food Engineering, American Institute of Chemical Engineers, Reno, Nevada, November 4-9.

Harrison, A.D., T. Zhou, R. McKellar, J. Odumeru, (UOG) C. Young, P. Piyasena, an d X. Lu (FRP, AAFC). The development of image analysis to objectively determine self life of ready to use lettuce. Regional annual meeting of Canadian Society of Plant Physiology, Guelph, ON, Dec 15.

Yang, S. X., Li, H. and Shi, J. (2002) Neural networks models for supercritical fluid extraction by. In: Proceedings of 4th International Symposium on Soft Computing for Industry (ISSCI'2002). Orlando, USA, June 9-13, 2002. 6 pages. Accepted.

Li, H., Yang, S. X., and Shi, J. (2001) Modeling of supercritical carbon dioxide extraction by artificial neural networks. In: Proceedings of 8th International Conference on Neural Information Processing (ICONIP'2001). Shanghai, China. November 11-18, 2001, pp. 337-342.

Li, H., Yang, S. X., and Shi, J. (2001) A novel neural network model for Supercritical Fluid Extraction. In: Proceedings of IEEE International Conference on Systems, Man and Cybernetics (SMC'2001). Tucson, USA, Oct. 7-10, 2001. pp. 1542 -1547.

Shi, J., Yang, S. X. and LeMaguer, M. 2001. Mass transfer modeling of supercritical CO2 fluid extraction of lycopene from tomatoes by neural networks. AAFC-Food Network, Guelph, June 7-8, 2001.

Shi, J., Yang, S. X., Li, H. and LeMaguer, M. 2001. Mass transfer modeling of supercritical CO2 fluid extraction of carotenoids from tomatoes by neural networks. Institute of Food Technologists Annual Meeting (IFT'2001). New Orleans, USA. June 23-27, 2001.

Shi, J., Yang, S. X. and LeMaguer, M. 2001. Mass transfer modeling of supercritical CO2 fluid extraction of lycopene from tomatoes by neural networks. Canadian Society of Agricultural Engineers (CSAE), and Northern Agricultural and biological Engineering Conference (NABEC) of ASAE, Guelph, Canada. July 8-12.

(d) M.Sc. Thesis and Reports

Ziwei, Liang. 2001. Inactivation of Salmonella typhimurium in orange juice by pulsed electric field. M.Sc. (FSQA)

Hodgins, Matthew A. 2001. Pasteurization of orange juice using pulsed electric field.

4.2 Current state of the industry

Down-sizing and consolidation of Canadian and U.S. operations continue to impact the structure of many Ontario food processing companies. Due to regional and global trade agreements, the food industry in Ontario is facing **international competition**. This will require considerable readjustment, productivity improvement and enhancement in product quality and safety. There is a large emphasis on value-added aspect of food processing. Downsizing putting less emphasis on R & D and more on organization aspects. Resources in Engineering R & D are decreasing due to overhead cuts and profit oriented approach. Food engineers are leaving to other industries and consulting due to less job satisfaction.

Last 3 years have seen the down side cycle of poultry industry. More and more companies develop synergies with other companies: together extra capacities, ie, shut downs of plants, selling lower than the cost of production (good for consumers) and sharing R&D with sister companies. Canadian food processing companies are being bought by US and European companies. Food processing companies from Quebec also buy Ontario food processing companies. Food processing companies see an increase in business despite tough competition and economic slow down. However, retailers are facing competition due to entry of big box stores in to grocery. In the cereal and baking sector, US companies buy Canadian baking manufacturers, and European dough conditioners/additives and enzyme manufacturing companies merge together in order to gain better market positioning and share.

R&D

Companies are cutting cost, R & D budgets are reduced, and most of the R&D went to USA. New companies such as Maple Leaf, invest in R&D. In general, less money is invested in R&D by the industries.

Industry driven research in universities and federal institutions is a concern as these were driven on short term benefits. The consequence would be disastrous in long terms, as basic research goes down. In general processors want to do short term research. We lack the industry shared (commodity based and/or product based: e.g.: wine, beer, cereal, dairy etc) national basic and applied research projects as in Japan and Europe, where a national project is shared by different universities, industries, and research institution across the nation or continent. e.g.: Reusable containers for F&V in Europe. European style R&D funding was appreciated by members. However, food processing companies in Canada still do the product development.

Government support to the R&D was discussed in length by the members. OMAFRA proposals require industry collaboration but it is not possible in most cases. Sector specific project proposals that are identified by the management as high priority are supported by NRC under IRAP as it brings more return for the money invested. AAFC is restructuring the research branch, setting new research priorities, and rethinking about Matching Investment Initiative (MII, contributions made by AFFC for industry supported collaborative projects). AAFC is focussing on research for the development of novel products and processes. Industry involvement in research proposal evaluation, approval, is urged. Currently, it is done mostly by academics. Developing a stream lined universal research proposal application form and evaluation process by the funding agencies and institutions would help the applicant as they do not need to rewrite the proposal from agency to agency and from institution to institution. It was felt that industries prefer to keep the intellectual properties of the research findings.

Less competition is being created due to merging as the number of owners are decreasing in each food sector. On the other hand, **Co-packing** is increasing where smaller food processors are processing foods for larger processors. For this reason and in general, small food processing companies are increasing in numbers. Employees at these companies are paid lower wages. Many small companies are producing specialized food products. Ethnic group food companies are also emerging to supply special food items to various communities.

However, these smaller processors are facing the followings: 1. Need of R&D on process and product development, 2. Need of whole infrastructure, 3. Compliance of processing facility sanitary, product safety, and labelling requirements as per USDA/FDA regulation for export, 4. Expansion of process lines to increase the output, 5. Developing process lines for multiple use or multiple products, and 6. Producing more and more value added foods. These factors increase the demand for research done by public institutions.

Smaller food processors look for short term projects. They are very innovative, and people with good technical and business background and ideas. They target value-added products and products for niche markets. However, they need R&D support. OMAFRA support in construction of processing plant is urged. OMAFRA and CFIA (certifying HACCP and guiding to set up guide lines) support HACCP set up. HACCP is also a big issue in poultry industry (hatcheries, egg production and poultry production). OMAFRA matches federal money for start up and operation. NRC provides financial support for research projects conducted by small and medium size (less than 500 employee) companies. However, there is not any funding program from these agencies and institutions for capital expenses such as upgrading the exiting facility with most efficient and sanitary equipment.

Education and training of workforce to properly use modern technology is lacking in food industry compared to other industries such as automobile industry. Due to the use of newer technology a wide gap is created between technology and training of workers.

Induction training and Continuing education/training

As the industry displacement cycle (due to rapid change in technology) is becoming shorter and shorter, life long learning (retraining, retooling) of the workforce is becoming important to be competitive in the market. Manufacturers point of view is that there should be a third party to do audit (annually/every 6months) and recommend the type of training required for each and every employee on Good Manufacturing Practices (GMP) annually but preferably every 6 months. It would be a very costly exercise and it would be very expensive for the small processing companies to do it on their own. Therefore exploring innovative and cost effective training methods such as Internet-based training are very important. The institutions such as OMAFRA, CFIA, and AAFC can develop web-based training programs for small companies and delivered through, Universities, Colleges, and ministry of labour.

Similar programs exist in other countries, for example, in Australia, every new employee in food processing companies has to go through the web-based training. Further Universities, colleges, and Government agencies can provide short courses and these training facilities should spread out across the province.

Every single employee/operator should be trained before using a piece of equipment; he or she should understand the operational, safety and principle, basic trouble shooting skills. Government should make this is mandatory and enforce it properly.

Qualified engineering graduates and trade personnel in food engineering

There is a shortage of food/food processing engineers in Ontario. Further New graduates (college and university) lack hands on experience, critical points judgement skills, and other judgement skills. This is mainly due to reduced number of practical and laboratory classes in Universities and colleges as less money is coming from the province to the universities and colleges. Lack of trained food engineering professionals in Canada was also identified in the Annual Report of Canada Committee on Food of CARC.

Recognition of food engineers

Food engineering professionals are not paid well compared to other engineering disciplines such as electrical, electronic and computer engineering. Therefore, it is very difficult to attract enough candidates to be trained in food engineering. Further, food engineering professionals are poorly paid in the government institutions compared to their counter parts in the private sector and in private practice. Therefore, it is very difficult to attract talented engineers to government institutions to work as researchers, inspectors, and advisors.

as well as other engineering disciplines: electrical, electronic and computer engineering. Therefore it is difficult to attract qualified and experience people to the government institutions as well as engineering schools are unable to find qualified candidates to be trained in food engineering.

Nutritional issues are important for the industry. **Nutraceuticals** are also being produced in Ontario, but progress is slow. Overall, Canada is behind USA in this respect. In fortification of food products, juices in particular, USA is leading due to advantages in regulations. Chemical analysis of nutraceuticals are needed as well as improved labelling regulations are required.

Products (juice) fortified with nutraceuticals are being produced and fortification to more and more foods is on the horizon; however, the presence of active ingredients in these products is questionable. Therefore, there is a need for new processing methods such as cold processing to preserve the active ingredients while inactivating microorganisms.

The industry and governments are slow to response to the increasing demand to these products and consumer awareness. Low rate of success of these products is due to lack of commercialization capabilities. Inventions die in the lab before even reach the pilot plants, as there are engineering problems that have to be solved.

USA has big market and fewer regulatory hurdles. Canada is planing to stream line with FDA in the regulation procedure. Small companies cannot afford to do nutritional analysis to put in the label therefore it was suggested that software-based calculation should be allowed, and has to be proved when challenged. Approval process is also very slow in Canada for health claim compared to USA.

Economic problems: For export, Canadian processed food is more attractive due to low value of Canadian dollar. However, imported equipment, machinery and raw material are more costly and it curtails innovation to improve productivity. The long term consequence would not be good for Canada.

Energy managements are needed by process and equipment modifications to reduce processing cost.

Mad cow disease in UK and Europe has created large demand for North American meats.

4.3 Emerging issues

Safety and Quality: Air quality in the plants is required to be maintained particularly where ovens are used. Discharging particles into air is becoming a problem. These particles are more harmful as they cause respiratory problems. Water quality for food processing is also becoming more critical. Effective use of water and reuse of wastewater are needed. Odour and wastes discharged from processing plants is also becoming a major concern.

Sensors for quality attributes and food safety are needed to effectively produce products with consistently high quality and greater consumer acceptance. For this, rapid and in-line methods for food analysis and quality control are required.

Water: Search for quality and quantity of water are becoming very important. Processing plants requires a large amount of good quality water. Currently the industries are not metered. However, in the future everyone in Ontario will be metered to monitor the water use regardless of the source. Therefore, recycling/treatment of used water/waste water becomes important. Such systems (recycling/treatment) exist in Europe and we can buy the units rather than reinventing the wheel. Setting up water quality standards for different products (beer, wine, meats, etc.) is also becoming important.

Odour: Standardized odour measurement method is required (Such standard exists in Australia)

Food safety issue: Reusing containers, especially in the meat industry, poses health risk. There is not any standardized procedure in place for cleaning. There should be regulations at all levels (federal, provincial and municipal). Food inspection regulations should be stream lined and it should be the same at all levels. Regulation and enforcement should be carried out without any size limitation and there should be a mechanism in place to make sure that the HACCP is practised by the processors and properly enforced by the inspectors. The existing regulations are not adequate to regulate the food processing area. However, the Bill 87-Food Safety and Quality Act will remedy this problem when this bill comes into effect.

Technological Challenge: Computer-dependant technologies continue to be important within the industry. Advances in instrumentation, automation and software, vision systems, and wider implementation of HACCP related quality control systems are all leading to wider use of computer technology. Vision scan and x-ray devices are needed for bruise detection on fresh produce, proper baking of cookies, and detection of worms and blood spots in food products.

Neutraceutical Processing: There seems to be interest in extracting neutraceuticals from soybean, tomato, hemp, etc. Appropriate separation technology is needed to extract active ingredients. Cold processing is required to avoid degradation of active ingredients. Research is also needed in purification and concentration of neutraceuticals.

This year OMAFRA allocated more funds for research in this area. Use (end use) of extracted compound has to be identified. Clinical study is required for health claim. It is an impediment, therefore, if a study was done elsewhere on a similar product and the claim was approved it should be adopted. More work has to be done in commercialization of these products.

Wine and beer Industry: Due to the growth of wine and beer industry especially, microbreweries, in Ontario, there are research needs in process engineering area. Micro breweries, are facing some problems such as: how to be profitable, more needs in processing knowledge and expertise, and using old equipment that is less energy efficiency, and costs more to repair.

Yeast was genetically improved. Over production is a concern as there are many small companies in the market and operating below economic of scale. Some work is done at Brock University.

Byproduct Utilization and solid waste management: Presently byproducts from many food industries are going for animal feeding. Research is needed to utilize the byproducts from corn, apple and grape processing industry.
Economical disposal of wastes is becoming a problem as the land and waterways are limited around the processing plants and strict regulation is being imposed. Cheese whey, soy processing waste, liquid egg processing waste, food packaging materials are some of the major sources. Making value added products from the under utilised or waste material would be an advantage therefore, more research in this area is required.

Dead animal composting: Pet food companies are not buying dead animals anymore for pet foods due the fear of mad cow disease, and antibiotics contents. As currently available incineration methods are expensive, low cost methods are being researched. Air pollution is an other problem in incineration. Therefore, it should be done on the farm. Alternative methods should be looked for.

Processing plant by products: Cataloguing the source, and the amount of food processing plant by composting by physical process other than thermal (using then methods requires compliance to regulations) has to be explored. R&D is being conducted to extract value-added products from processing plant products driven by individual companies but not by industry as a whole.

5.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS

Food Safety Research Program - 2001
In October 2000, OMAFRA committed four million dollars to a four-year Food Safety Research Program. The purpose of the research program is to analyze emerging hazards and contaminants, and improve efficiencies by developing more effective and faster tests, including quick field tests. The program will help in the implementation of a science-based food safety system. However, no fund has been awarded for food engineering proposals.

Special Research Program - 2001
Thirty-three research projects were approved for funding through the Special Research Program in 2001 in the following areas by OMAFRA: Value-added food and non-food products, Alternative livestock species in Ontario, Antimicrobial resistance, Food safety risk assessment and risk control, A healthy environment Pesticide reduction and usage.

New Directions in Agri-Food and Rural Research Program - 2002
For 2002, the Special Research Program has been renamed the New Directions in Agri-food and Rural Research Program to better reflect its intent by OMAFRA. The priorities for research in 2002 are: Value-added food, Value-added Non-food Uses of Agricultural Materials, Alternative Livestock Species, Healthy Environment, including Rural Issues, and Pest Management.

WASTE DIVERSION ACT, 2001 - BILL 90
The Waste Diversion Act is enabling legislation that will allow for the development of an organization, regulations and programs to address waste diversions in Ontario. Key designated wastes being considered are: Blue Box materials including consumer packaging (food and beverage containers made of aluminum, steel, glass and plastic), newspaper, cardboard and box board. Industry will be expected to pay for up to half of the net costs of the Blue Box program. The other half will come from municipalities.

ARIO Response to Food Engineering Recommendations
ARIO recognizes the research priorities contained in the recommendations presented by the Food Engineering subcommittee. Research into food processing is supported by OMAFRA through the Food Program of the Enhanced Partnership with the University of Guelph and also through the Special Research and other competitive research programs.

The limited human and financial resources available dictate that all priorities cannot be addressed simultaneously. In order to address new issues or expand work in existing priorities research in existing areas must be either scaled back or completed to make the resources available. OASCC committees can assist in this process by identifying research areas which are no longer high priority.

A mechanism has been put in place to redirect resources within the Enhanced Partnership Agreement to high priority areas which are not currently being adequately addressed. Committees will need to identify areas which are the highest priority and also which areas of research can be reduced.

The University of Guelph has developed a food research program for the next four years which was presented to ARIO in April. This proposed program is based on the industry needs as identified by OASCC committees such as your own. The research priorities identified in committee reports are used to determine if the proposed program meets the industry needs and that the proposed allocation of resources is in line with the priority assigned to those needs by the committees.

It was noted that the Food Engineering Research and Services committee submitted their report to the Food Processing Research and Services committee for consideration. We continue to encourage communication and cooperation between committees. As well, we would encourage discussion between the Engineering and Food committees to determine how the Food Engineering Committee can serve the mandate of both committees.

The move of Agriculture and Agri-Food Canada researchers from Ottawa to Guelph and the completion of AAFC new facility will provide further opportunities for increased collaboration between the University of Guelph and federal researchers allowing more efficient use of resources.

Food Research Program 2000-2004

This year the Food Research Program was reviewed and a long term program has been developed to effectively use resources within the University of Guelph, including clusters funded recently by the Canadian Foundation for Innovation and Ontario Innovation Trust, as well as collaborating organizations (e.g. Agriculture and Agri-Food Canada, Health Canada, Canadian Food Inspection Agency, Guelph Food Technology Centre) to address research priorities of the Ontario Agricultural Services Coordinating Committee (OASCC). Research needs identified through the Food Industry Competitiveness Branch of OMAFRA (as reported in the OFPRSC 1999 Strategic Report for 2000 - 2004) and the Canada Committee on Food, a committee of the Canadian Agri-Food Research Council (CARC) have also been considered.

The objectives and goals were set for this period (2000-2004)

Objective 1: Ensure safety and improve quality of Ontario food products.

To ensure that Ontario food products maintain their high quality standards in terms of microbial safety as well as sensory and nutritional factors while addressing the concerns of producers, processors and consumers, research efforts are directed to achieving the goals.

Intervention strategies (e.g. changes in management practices, changes in processing procedures or development of novel processing approaches) are central to any successful quality improvement. The fundamental knowledge developed through understanding of relationships between molecular structures and functions of food components related to quality (sensory, microbial safety and nutritional factors) would be used to identify potential intervention strategies. For example, better understanding of how microorganisms interact with food components will be used to develop strategies to extend shelf-life while ensuring safety.

The research needs related to Food Engineering are identified in Section 6.0

Objective 2: Develop value-added components in Ontario-grown food products.

Recently, scientists have demonstrated that the consumption of certain foods can have specific health benefits beyond providing essential nutrients, energy and pleasurable sensations. This discovery has revolutionized the field of nutritional sciences (now called nutritional and nutraceutical sciences) and is beginning to have a major impact on the food and agricultural industries in Canada.

Research activities under this goal include isolation of functional components in foods produced in Ontario, analysis of the effects of extraction techniques and processing on the stability and bioavailability of functional components and development of new functional foods and nutraceuticals.

The research needs related to Food Engineering are identified in Section 6.0

Objective 3: Design innovative technologies to manufacture traditional and new food products.
Research activities under this objective focus on developing food manufacturing technologies that are acceptable in terms of sustainability, competitiveness and consumer values. Process design research includes scale-up from laboratory procedures as well as evaluation of process economics at each stage of scale-up. These objectives mainly deal with Food Engineering and the goals are given below.

Goal 3.1 Develop appropriate technologies to extract and stabilize value-added components from Ontario agricultural resources as well as manufacturing waste streams.
In the program, this includes technologies to extract valuable components from unprocessed agricultural materials, recovery of components from manufacturing waste streams, and stabilization of functional components. Extraction technologies include the use of novel solvents such as supercritical carbon dioxide as well as innovative combinations of enzymes and fractionation methods. Process design requires teams of food scientists and engineers since it is critical that separation and stabilization do not degrade functionality. Also, it is important to incorporate economic analysis at preliminary design stages. Otherwise, recovery costs may reduce the "value added" to a minimal or negative value.

Goal 3.2 Improve existing and develop new technologies for food preservation.
Food preservation includes post-harvest stabilization and large-scale storage as well as innovative packaging systems to maintain quality and extend shelf life of food products. The design of complete food packaging systems requires integration of post-harvest physiology, preservation methods, microbiology and packaging materials science. Research will focus on packaging performance relative to food quality requirements (including safety and sensory quality) as well as integrated preservation and packaging technologies (e.g. modified atmosphere environments).
Post-harvest research will also focus on understanding and controlling metabolic processes that occur during storage. Fundamental knowledge of postharvest physiology in fruits and vegetables will allow for effective management of storage conditions and/or development of treatments to extend shelf life.

Sub-Committee Response:
Some of the major research needs were considered in the Food Program 2000-2004. It is a good sign compared with last 4 years.

This year like in the last year, sub-committee is providing recommendations project-wise. Not much work has been done on many past recommendations. Therefore, some projects are being recommended again.

Since food industry is the second largest industrial sector in Ontario, and food industry is facing many engineering related problems, more resources are needed for food engineering research.

The subcommittee welcomes the targeted new funding for nutraceuticals (Special Research Program - 2001, New Directions in Agri-Food and Rural Research Program - 2002) and safety (Food Safety Research Program - 2001). However, the amount allocated for food engineering is negligible. The subcommittee also welcomes the WASTE DIVERSION ACT, 2001 - BILL 90, and the Bill 87-Food Safety and Quality Act. The latter is very important as it will regulate the construction of processing facilities regardless of their size.

6.0 STRATEGIC DIRECTIONS/PROBLEMS OR ISSUES/SECTOR PRIORITY

(Include new issues and comments)

RESEARCH

1. Advanced and novel food processes for better productivity, quality and safety of food

One of the processes identified is the non-thermal pasteurization of liquid foods using pulsed electrical field. The work is being conducted for the last few years at the School of Engineering, University of Guelph. Several hurdles have been removed. However, more work is needed to make this process commercially viable.

Radio frequency heating is being investigated as an alternative to conventional high-temperature-short-time pasteurization at AAFC research facility in Gueph, Food Research Program.

Using radio frequency as a heating method has the advantages of rapid and uniform heating, high penetration depth and short residence times. Guelph scientists are assessing the dielectric properties of food, especially, viscous and heat sensitive food, to develop radio frequency heating for the Canadian food processing sector.

Three processes identified are deep-fat frying, pan-frying and baking. Some work on deep-fat frying is in progress at the School of Engineering. Work is needed in the areas of pan-frying of meat patties for E.coli safety, and on baking for better product quality.

High pressure processing (HPP) is becoming an important commercial cold food preservation technology in Europe, USA, and Japan. However, its application is limited in Canada and there is not any commercial or experimental unit in Ontario. This process not only inactivates the microbes but also maintains the quality thus it is good for neutraceuticals and foods fortified with neutraceuticals. The subcommittee recommends this is an urgent need. Collaboration between federal and provincial governments in this area is urged.

Ozone application to fruits and vegetables (reducing waste and chlorine use) and its potential application to grains (to replace CO_2 and Fumigants) to prevent bacteria, fungus and mould is another area to be investigated. A large quantity of fruit and vegetables is produced in Ontario during the summer. However, these produces cannot be economically stored for long time and finding new ways to preserve them at reasonable cost would increase the income to farmers and reduce the cost to consumers. This also cut down on chlorine use and disposal.

CRIFS had submitted a proposal to Canadian Foundation for innovations for the amount of $6.5M. If successful, closer to $2.0M will be used to buy equipment to set up a nonthermal processing facility that would be unique in Canada.

The price and the demand for beans grown in Ontario are very low and there is a need for increasing the price and the demand. There are research needs in new product and process developments such as ready to eat meals, easy digestible products, easy cooking products, and uniform dehydration process.

2. Sensors, image processing and automation for higher productivity, safety and quality

In-line sensors for the detection of contaminants and quality parameters in foods are needed for consumer safety and product quality. Three processes were identified for image processing: inexpensive in-line methods for detection of glass pieces in glass containers, small chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans. No work is in progress on these areas.

Three in-line sensors were identified: for microbial detection, moisture at high temperature for baked foods and dough properties. Some work is in progress on microbial sensors in the University

3. Neutraceutical processing – separation, purification and concentration

Work is needed on the development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods. Some work is in progress in the University of Guelph, and AAFC Laboratory in Guelph. However, more work is needed and these needs were also identified by CARC.

4. By products utilization and environmental (waste and air quality) quality

Applied research is needed to develop value-added food and non-food product from food waste and reducing air and water pollution.

5. Characterization of raw ingredients for quality control in processed foods

No work is in progress in Ontario on this or related topic.
There is a need for low cost and high quality locally produced ingredients for small and medium sized companies. Evaluation of raw materials and ingredients for their physical and functional properties are important.

There is a need to develop novel ingredients to replace existing ones. Baking industry has started replacing the emulsifiers with enzymes. Labelling is not required for those additives. Ontario lacks in manufacturing/supplying these ingredients therefore Ontario baking industry depends on outside suppliers(Quebec, USA, Europe).

6. Wine and beer industry growth in Ontario requires optimum material handling

Applied research is needed in this area for expanding Ontario wine industry. Some work is in progress at present.

7. Processes development for new products for small processes

There is a need to do research to develop small scale processing units for small scale processors such. The needs are due to the new regulations for cider pasteurization and small scale production of value-added products like nutraceuticals. Therefore small scale processing units have to be developed and evaluated for their technical and economical feasibility.

8. New material to replace stainless steel and for new processes.

New materials other than stainless steel (such as polyethylene tanks, PVC piping, aluminum) for storage, handling, and processing of food materials are being used more and more in food processing. However, there is insufficient information available on the interaction between the food and these materials, and safety of their use. Further, the new processes such as pulse electric field, radio frequency heating requires special material other than stainless steel to withstand the high voltage, and high pressure at high temperatures. Therefore, there is a need to do research to develop and evaluate new materials for specific process as well their interaction between food and safety.

SERVICE

1. Training

a. Induction training and Continuing education/training

As the industry displacement (due to rapid change in technology) is becoming shorter and shorter, life long learning (retraining, retooling) of the workforce is becoming important to be competitive in the market.

b. Qualified engineering graduates and trade personnel in food engineering

There is a shortage of food/food processing engineers in Ontario.

c. Recognition of food engineers

Food engineering professionals are not paid well compared to other engineering disciplines such as electrical, electronic and computer engineering. Therefore, it is very difficult to attract enough candidates to be trained in food engineering. Further, food engineering professionals are poorly paid in the government institutions compared to their counter parts in the private sector and in private practice. Therefore, it is very difficult to attract talented engineers to government institutions to work as researchers, inspectors, and advisors.

2. Water quality standards and standardized odour measurement methods

Setting up water quality standards for different products (beer, wine, meats, etc.) is also becoming important. Standardized odour measurement methods are required (Such standard exists in Australia) to monitor and control odour problems.

3. Stream lined and harmonized food inspection regulations

Stream lined and harmonized food inspection regulations at all three levels of government (federal, provincial and municipal) will improve the safety of the food and help the processors to comply without any confusion and help inspectors to enforce easily.

4. Support for HACCP set up, and provide funding for small processors to upgrade the processing equipment.

Support structure is not available at OMAFRA for small industries for research, upgrading the old processing equipment, and establishing HACCP system.

5. Regulations for food processing plant construction and reusable containers

The existing regulations are not adequate to regulate the food processing area. However, the Bill 87-Food Safety and Quality Act will remedy this problem when this bill comes into effect.

Standardized cleaning procedure for reusable containers in the meat industry is required as these containers are used again and again by small processors without cleaning them by using any standard procedure.

6. Developing a stream lined universal research proposal application form

Developing a stream lined universal research proposal application form and evaluation process by the funding agencies and institutions would help the applicant as they do not need to rewrite the proposal from agency to agency and from institution to institution.

7.0 RECOMMENDATIONS ARISING FROM THE GAPS/BARRIERS/DEFICIENCIES

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

RESEARCH

Recommendation #1a
Issue: Advanced and novel food processes for better productivity, quality and safety of food

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO and OMAFRA.

Title: Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life.

Details:
The new and improved non-thermal pasteurization processes should increase product quality and process efficiency. Novel technologies are needed to safely extend shelf life without perceptibly altering the natural flavour, composition and taste of foods. The new technologies should maintain product quality standards and integrity, minimize energy utilization, and maximize yields.

The beverage industry has an immediate need for replacing thermal pasteurization as consumers are interested in minimal processed and fresh-like fruit juices. The conventional process is not only energy intensive but denature the products' colour, flavour and vitamin content. There is great need for a non-thermal pasteurization that is safe, energy efficient, economical and does not affect nutrition and flavour. Wine manufacturers are also interested in non-thermal pasteurized grape juice for better flavour of wines.

Background:
The food manufacturing industry is facing increasing global competition, government regulations and consumer demands. These challenges require adoption of new technologies and methodologies to create and sustain a competitive advantage in the marketplace.

Even a small improvement in manufacturing technology through technological innovation, efficiency improvements or resource utilization would have a large economical effect on food industry given its size. A 1% improvement in productivity by improved and novel technologies will save $50 million per year.
The recommendation should be addressed by research institutions and universities, food industry, and collaborative research between industry and academic researchers. There is some current research activity at the School of Engineering, University of Guelph in this area.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

RESEARCH

Recommendation #1b

Issue: Advanced and novel food processes for better productivity, quality and safety of food

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC and OMAFRA.

Title: Baking and frying processes modelling to improve baked and fried products' quality.

Details:

Modern cooking systems are becoming complex due to industry's expanding need for higher production, short cooking time, consistency and better quality, higher yield, energy efficiency and versatility. The models will provide a better understanding of the process mechanisms, assist with better design of equipment and process, and will promote the more efficient use of existing equipment. A detailed understanding of the fat transfer profile is of major interest to processors as consumers are more aware about the amount of fat they consume. Optimization of the process parameters will result in better process control, product quality, and lower fat. Pan-frying process required to be studied with respect to the changing physical properties and chemical composition of beef patties during cooking and consequent microbial destruction.

Heat, moisture and fat transfer within the food and crust formation occur during cooking including deep-fat frying, broiling, baking, pan frying. Cooking is still considered more of an art than a science. For cooking to be adequately controlled, designed and optimized, the food quality kinetics during cooking must be understood. Fried foods constitute a large percentage of the snack food industry. Research on frying has generally concentrated on the kinetics of oil degradation. Little is known about the fat transfer during frying as affected by edible coatings of frozen products. Recent consumer trend toward healthier foods is creating significant pressure to reduce fat in cooked products. Fried foods still contain a large amount of fat, in some cases >45%. Excess fat consumption is considered as the key dietary contributor to coronary heart disease and cancer of breast, colon and prostate.

Background:

As the market for fully cooked products continues to expand, modelling and simulation that predict product temperature, cooking yield, and pathogen lethality during cooking will be valuable tools for designing effective and safe thermal processes. With the increasing concern on safety and quality of beef and chicken patties, the importance of prediction of heat and fat transfer, microbial lethality and optimization of pan-frying is evident. The development of in-line sensors and process modelling and optimization will be critical in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario's GDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

RESEARCH
Recommendation #2a

Issue: Sensors, image processing and automation for higher productivity, safety and quality

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC and OMAFRA.

Title: Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans.

Details:

Baby foods and fruit juices are generally filled in glass containers due to consumer preference. During filling of foods or juices in glass containers at high speed, occasionally, a few glass containers are shattered due to impact. Consequently, a few pieces of broken glass with variant sizes may find their way into the containers during this shattering process. To detect containers that contain glass pieces, a scanning system is needed. For this system to be of practical value it has to be cost effective and fast enough so as to cope with the speed of the filling process. Currently, there are a few systems in the market. These systems are based on x-ray technology. Unfortunately, the speed and high cost of such systems are among the major factors that hinder their use in these applications. Since popularity of ground chicken products are increasing, the demand for deboned chicken is also increasing. Detection of small chicken bones in deboned meat is difficult. An in-line detection system is needed so that these small pieces of bones can be separated. Similarly sclerotia due to black fungus in white-beans reduces the quality of the product. Image processing based method seems to be suitable for the separation of sclerotia.

Background:

The development of in-line image processing detection devices for above-mentioned problems will be critical for food safety and quality, and in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario's GDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

RESEARCH

Recommendation #2b

Issue: Sensors, image processing and automation for higher productivity, safety and quality

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, CCF and OMAFRA.

Title: In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties

Details:

Due to complex nature of food and its processing, in-line sensing of food quality and microorganisms is needed. Inexpensive and reliable sensors and methods are needed for these. Process controls need measurement of key process parameters to determine the current operating conditions. In-line sensors for monitoring many food quality and safety parameters are not available.

Control of optimized processes is presently limited not by lack of computer or control devices, but by lack of sensors to measure specific food properties. Development of suitable sensors is needed for control systems to measure the critical process parameters and assist in their control. The lack of sensors and control systems for food processes is a major impediment to development of a fully automated food processing system.

Artificial neural network (ANN) is a useful tool for real-time prediction of data and for online process control.

Background:

The development of in-line sensors, ANN and process modelling and optimization will be critical in implementing total quality management (TQM) and HACCP in the food industry. The food industry represents about $5 billion of Ontario's GDP. A 1% improvement in productivity through improved process control represents $50 million.

Collaborative research on these needs is required between researchers from research institutions and universities and food industry.

RESEARCH
Recommendation #3

Issue: Neutraceutical processing -- separation, purification and concentration

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC and OMAFRA.

Title: Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.) to be used in supplements and in fortified foods.

Details:

The separation, purification and concentration of neutraceuticals and functional foods are critical for their quality and functionality. Neutraceuticals and functional foods will be used in supplements and in fortified foods. Suitable process is needed for isolating isoflavones from soybeans. A significant body of work is required to understand the properties of neutraceuticals and to develop process technologies that ensure the functionality of these ingredients remains intact. This is an area of high interest to many in the food business.

Background:

The neutraceutical market is increasing day by day. If Canadian food industry will not develop the products containing neutraceuticals, then consumers will get the foods fortified with neutraceuticals from USA or other countries.

This recommendation should be addressed by the industry, research institutions and academic researchers.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

RESEARCH
Recommendation #4

Issue: Waste management and air and water pollution control.

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, FCC and OMAFRA.

Title: By-products utilization, waste management and air and water pollution control.

Details:
Economical disposal of wastes is becoming a problem as the land and waterways are limited around the processing plants and strict regulation is being imposed. Presently byproducts from many food industries are going for animal feeding. Research is needed to utilise the byproducts from corn, apple, and grape processing industry. Other sources of waste are cheese whey, soy processing waste, liquid egg processing waste, food packaging materials are some of the major sources. Processing waste can be minimised by reducing the byproducts generation and utilising them to produce value-added food and non-food products.
Water quality and air quality for food processing is also becoming more critical. Effective use of water and reuse of wastewater are needed. Removal of Odour and particles from the air coming from food processing plant is becoming very important.

Background:
Producing value-added food and non-food products from the under utilised or waste material and finding economical ways to reduce water and air pollution generated by the food industry would be an advantage to the industry therefore, more research in this area is required

This recommendation should be addressed by the industry, research institutions and academic researchers. It is difficult to estimate the economical impact on this.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

RESEARCH
Recommendation #5

Issue: Characterization of raw ingredients for food quality control in processed foods

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, FCC and OMAFRA.

Title: Raw material characterization for product quality.

Details:

There is quite a large variability in raw food material (cereals) from year to year and batch to batch. These variabilities are affecting functionality of the ingredients particularly for cereal industry manufacturing breakfast cereals, breads, cookies, etc. This research will minimize undesirable changes due to processing, and will improve productivity. The present lack of sufficient data on physical properties of basic food ingredients and products has limited the application of many well established engineering principles.

Background:

The quantification and modelling of food properties and processes will be critical in improving the productivity in food industry. Based on the improvement in the productivity by this research of 0.5%, the net saving to the food industry will be $25 million per year.

This recommendation should be addressed by the industry, research institutions and academic researchers.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

RESEARCH
Recommendation #6

Issue: Wine and beer industry growth in Ontario requires optimum material handling

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, CCF and OMAFRA.

Title: Optimizing material handling in wine industry.

Details:

Due to the rapid growth of wine and beer industry in Ontario in recent years, there is a need to improve its productivity. One of the areas suggested is the optimization of material handling so that process efficiency can be improved, byproducts can be minimized and utilized, and processing wastage can be minimized.

Background:

The optimization of material handling will be critical in improving the productivity in wine industry. Applied research is needed in this direction so that the wine industry can use the information without doing in-house research or trial approach.

Some research is also needed to minimize and utilize processing waste from the wine industry.

This recommendation should be addressed by the industry, research institutions and academic researchers. It is difficult to estimate the economical impact on the wine industry.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

RESEARCH
Recommendation #7

Issue: Process development, product safety, good manufacturing practices for small processors

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, FCC and OMAFRA.

Title: Process development for new products for small processors

Details:

Due to the rapid expansion of small food processors who has very little capital to invest in short term R&D and long term high risk research, there is a need for conducting research at public research institutions. These research institution should focus on process and product development suited for small processors and to produce small scale speciality products to increase the profit. Lack of research support would make the long term survival of these processors questionable.

Background:
The statistics shows that small companies are hiring more people and the long term survival of small food processors would be an added benefit to the economy of the province.

This recommendation should be addressed by the industry, research institutions and academic researchers.

RESEARCH

Recommendation #8

Issue: New material to replace stainless steel and to use in new processes

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, AAFC, CCF and OMAFRA.

Title: New material to replace stainless steel and to use in new processes

Details:
New materials other than stainless steel (such as polyethylene tanks, PVC piping, ceramics, aluminum) for storage, handling, and processing of food materials are being used more and more in food processing. However, there is insufficient information available on the interaction between the food and these materials, and safety of their use. Further, the new processes such as pulse electric field, ultrasound, and radio frequency heating require special material other than stainless steel to withstand the high voltage, ultrasound, and high pressure at high temperatures. Therefore, there is a need for research to develop and evaluate new materials for specific process as well as their interaction between food and safety.

Background:
This recommendation should be addressed by the industry, research institutions and academic researchers.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

SERVICE

Recommendation #1

Issue: Qualified food engineering graduates and trade personnel and continuing education.

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, CCF, universities and OMAFRA.

Title: Providing induction training and continuing education/training for employees in the food processing sector, producing more qualified food engineering graduates and trade personnel, and the recognition of food engineering professions.

Details:

As the industry displacement cycle (due to rapid change in technology) is becoming shorter and shorter, life long learning (retraining, retooling) of the workforce is becoming important to be competitive in the market. It would be very expensive for the small processing companies to do the training on their own. Therefore, exploring innovative and cost effective training methods such as Internet-based training are very important.

Every single employee/operator should be trained before using a piece of equipment; he or she should understand the operational, safety, principle, and basic trouble shooting skills. Government should make this is mandatory and enforce it properly.

There is a shortage of food engineering graduates and trade personnel in Ontario. Further New graduates (college and university) lack hands on experience, critical points judgement skills, and other judgement skills.

Food engineering professionals are not paid well compared to other engineering disciplines such as electrical, electronic and computer engineering. Therefore, it is very difficult to attract enough candidates to be trained in food engineering. Further, food engineering professionals are poorly paid in the government institutions compared to their counter parts in the private sector and in private practice. Therefore, it is very difficult to attract talented engineers to government institutions to work as researchers, inspectors, and advisors.

Background:

The food manufacturing industry is facing increasing global competition, government regulations and consumer demands. These challenges require adoption of new technologies and methodologies to create and sustain a competitive advantage in the marketplace. Therefore, the workforce in food processing industry should have the knowledge, tool and experience to handle the rapidly changing technologies and regulations.

The recommendation should be addressed by universities, food industry, GFTC, and federal and provincial governments. The training activities at GFTC, and UOG should be strengthened and expanded to include and increase more food engineering components. Further, co-op programs at federal government institutions (such as AAFC) and industries should be expanded to include more students.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

SERVICE

Recommendation #2

Issue: Quality standards for water used in food processing plants and standardized odour measurement method.

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, CCF, Environment Canada and OMAFRA.

Title: Setting up water quality standards for different products (beer, wine, meats, etc.) and standardized odour measurement method.

Details:
Search for quality and quantity of water are becoming very important. Processing plants requires a large amount of good quality water. Currently the industries are not metered. However, in the future everyone in Ontario will be metered to monitor the water use regardless of the source. Therefore, recycling/treatment of used water/waste water becomes important. Setting up water quality standards for different products (beer, wine, meats, etc.) is necessary.
Standardized odour measurement method is also required (such standard exists in Australia) to control this issue effectively.

Background:
The recommendation should be addressed by research institutions and universities, food industry, ARIO, CCF, and OMAFRA, and Environment Canada.

SERVICE
Recommendation #3

Issue: Stream lined and harmonized food inspection regulations at all three levels of government (federal, provincial and municipal).

OASCC linkage: Food processing committee.

Target agencies: Recommendation to AAFC, ARIO, CARC, CCF, Health Canada and OMAFRA.

Title: Developing stream lined and harmonized food inspection regulations at all three levels of government (federal, provincial and municipal) for all sizes of food processing facilities.

Details:
Food safety is the number one issue in food industries. An out break can kill a company overnight and bring great political pressure on governments. Even though the safety record of Ontario food industry is good, government should make sure that the adequate preventive measures are in place. Further, the recent report on food safety by Auditor General of Ontario should also be taken into consideration. In Ontario there are 3 levels of governments (federal, provincial and municipal) that are involved in regulation of food industry. Food inspection regulations should be stream lined and it should be the same at all 3 levels of governments and for all sizes of food processing facilities.

Regulation and enforcement should be carried out without any size limitation and there should be a mechanism in place to make sure that the HACCP is practised by the processors and properly enforced by the inspectors.

Background:
The recommendation should be addressed by food industry, AAFC, ARIO, CARC, CCF, Health Canada and OMAFRA.

SERVICE
Recommendation #4

Issue: Support for HACCP set up, and provide funding for small processors to upgrade the processing equipment.

OASCC linkage: Food processing committee.

Target agencies: Recommendation to ARIO, CCF, CFIA and OMAFRA.

Title: Lack of support for HACCP set up, and fund for small processors to upgrade the processing equipment.

Details:
Food safety is the number one issue in food industries. An out break can kill a company overnight and bring great political pressure on governments. Even though the safety record of Ontario food industry is good, government should make sure that the adequate preventive measures are in place. Further, the recent report on food safety by Auditor General of Ontario should also be taken into consideration. There should be a mechanism in place to make sure that the HACCP is practised by the processors and properly enforced by the inspectors. Therefore, OMAFRA should help the small processors to set up HACCP and also assist in upgrading the equipment that are inefficient and not comply with the current regulations.

Background:
There are more and more small food processors getting into the market. Smaller food processors are very innovative, and people with good technical and business background and ideas. They target value-added products and products for niche markets. However, they need support for the construction of processing plant and HACCP set up.

The recommendation should be addressed by ARIO, CCF, CFIA and OMAFRA

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

SERVICE
Recommendation #5

Issue: Regulations for reusable containers in the meat industry.

OASCC linkage: Food processing committee.

Target agencies: Recommendation to AAFC, ARIO, CCF, CFIA and OMAFRA.

Title: Setting up (OMAFRA) regulations for food processing plant construction and cleaning procedure for reusable containers in the meat industry.

Details:
Reusing containers, especially in the meat industry, poses health risk. There is not any standardized procedure in place for cleaning. Therefore, it is not very easy for the HACCP and other regulations to be enforced. Further, such regulations would be helpful to the food inspectors.

Background:

The recommendation should be addressed by food industry, AAFC, ARIO, CCF, CFIA and OMAFRA.

Ontario Agricultural and Food Engineering Research and Services Committee
Food Engineering Subcommittee

SERVICE
Recommendation #6

Issue: Stream lined universal research proposal application form and evaluation process by the funding agencies and institutions.

OASCC linkage: Food processing committee.

Target agencies: Recommendation to AACF, ARIO, CARC, CCF, Health Canada and OMAFRA.

Title: Developing a stream lined universal research proposal application form and evaluation process by the funding agencies and institutions.

Details:
Canadian food processing companies are being bought by US and European companies. Companies are cutting cost, R & D budgets are reduced, and most of the R&D went to USA. New companies such as Mapleleaf, invest in R&D. However, generally, less money is invested in R&D by the food industry. We also lack the industry shared (commodity based and/or product based: e.g.: wine, beer, cereal, dairy etc.) national basic and applied research projects as in Japan and Europe, where a national project is shared by different universities, industries, and research institution across the nation or continent.

Developing a stream lined universal research proposal application form and evaluation process by the funding agencies and institutions would help the applicants as they do not need to rewrite the proposal from agency to agency and from institution to institution.

Industry involvement in research proposal evaluation, approval, is lacking. Currently, it is done mostly by academics. Participation from the industry should be increased.

Background:
As fund available for research is decreasing and the demand and competition for such fund are increasing, the government institutions and agencies at all levels and the other funding institutions such as commodity groups and associations should get involved in this process.

The recommendation should be addressed by food industry, federal and provincial government institutions and agencies (OMAFRA, CFI, AAFC, Health Canada, and CFIA), ARIO, CARC, CCF, and commodity groups and associations that fund research.

8. SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS:

RESEARCH

To Agencies

Recommendation	AAFC	ARIO	CCF	CARC	OMAFRA	Other
1a. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life	X	X			X	
1b. Baking and frying processes modelling to improve baked and fried products' quality.	X	X			X	
2a. Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans	X	X			X	
2b. In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties	X	X	X		X	
3. Development of efficient methods for separation, purification and concentration of neutraceuticals from various sources (soybean, tomato, hemp, etc.)	X	X			X	
4. By-products utilization, waste management and air and water pollution control.	X	X	X		X	
5. Raw material characterization for food product quality	X	X			X	
6. Optimizing material handling in wine and beer industry	X	X	X		X	
7. Process development for new products for small processors	X	X	X		X	
8. New material to replace stainless steel	X	X	X		X	

9.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS:

SERVICE

To Agencies

Recommendation	AAFC	ARIO	CCF	CARC	OMAFRA	Other
1. Providing induction training and continuing education/training for employees in food processing sector, producing more qualified food engineering graduates and trade personnel, and the recognition of food engineering professions.		X	X	X	X	UOG
2. Setting up water quality standards for different products (beer, wine, meats, etc.) and standardized odour measurement method.		X	X		X	Env. Canada
3. Stream lined and harmonized food inspection regulations at all three levels of government (federal, provincial and municipal).	X	X	X	X	X	CFIA, Health Canada
4. Support for HACCP set up, and provide funding for small processors to upgrade the processing equipment.		X	X		X	CFIA
5. Regulations for reusable containers in the meat industry.	X	X	X		X	CFIA
6. Developing a stream lined universal research proposal application form and evaluation process by the funding agencies and institutions.	X	X	X		X	CFIA, Health Canada

FOOD ENGINEERING SUBCOMMITTEE 2000-01

Name	Organization	Address	phone/fax/email
Peter Ateba	Dairy World	ACCL Oakville, ON	Ph: (905) 849-3293 Fax: (905) 845-6179 petera@dairyworld.com
Dave Delevante	Nacan Products Ltd	201 MacDonald Road Collingwood, Ontario L9Y 4J1	Ph: 705-445-1140 x232 Fax: 705-445-9402 dave.delevante@nstarch.com
Bob Fotheringham	Ontario Bean Producers	140 Raney Cres., London ON N6L 1C3	Ph: (519) 652-3566, Fax: (519) 263-3034 rfother@tcc.on.net
Hugh Fraser	OMAFRA Horticultural Research Institute of Ontario	Vineland Station, Ontario L0R 2E0	Ph: (905) 562-4147, Ext. 304 Fax: (905) 562-5933 hfraser@omafra.gov.on.ca
Frank Holmes	ITA, NRC, Dept. of Food Science	University of Guelph, Guelph, Ont., N1G 2W1	Ph: (519) 824-4120 Ext. 3877 Fax: (905)824-6631 frank.holmes@irap.nrc.ca
Susan Iler (seeking repalcement)	OntarioSoybean Growers Marketing	Board, P.O. Box 1199 Chatham, Ontario N7M 5L8,	Ph: (519) 352-7730 Fax: (519) 352-8983 siler@ciaccess.com
Diana Iwaniw	Sandwell Inc.,	Suite 100, 1016B Sutton Drive, Burlington, Ontario L7L 6B8	Ph: 905-319-1666 Fax: 905-319-1801 Diwaniw@sandwell.com
Ian MacKinnon	Jamesway Incubator Co., Ltd.,	30 High Ridge Court, Cambridge, Ont., N1R 7L3	Ph: 519-624-4646, Fax: 519-624-5803 ianmack@jamesway.com
Gauri S. Mittal (Past Chair)	School of Engineering,	University of Guelph Guelph, Ontario N1G 2W1	Ph: (519) 824-4120 ext. 2431 Fax: (519) 836-0227 gmittal@uoguelph.ca
Punidadas Piyasena (Chair)	Food Research Program, Agric. & Agric-Food Canada	95 Stone Road West, Box 3650, Guelph, ON N1H 8J7	Ph: (519) 829-2400 Ext. 3147 Fax: (519) 829-2600 piyasenaP@em.agr.ca
Gaurav Tewari	Guelph Food Technology Centre	88 McGilvray St., Guelph, ONTARIO, N1G 2W1	Ph: (519) 821-1246(Ext.5019) Fax: (519) 836-1281 gtewari@uoguelph.ca
Albert Verbeem	Nestle Foodservices	P.O. Box 1800, Douglas Road, Trenton, Ontario, K8V 5S7	Ph: (613) 394-3328 Ext 274, Fax: (613) 394-4712 al.verbeem@ca.nestle.com
Ping F. Wu	Ansatec	8 Silas Hill Drive, North York, Ontario, M2J 2X9	Ph: (416) 726-6298 Fax (416) 490-6659 pingwu@ansatec.com
Robin L. Williams	Consumer Foods Division, Robin-Hood Multifoods, Inc.	191 Attwell Dr., Unit 4, Etobicoke, Ont., M9W 5Z2	Ph: (416) 675-2541 Ext. 246, Fax: 416-675-6194 robin.williams@robinhood.ca

FOOD ENGINEERING SUBCOMMITTEE 2001-2002

Name	Organization	Address	phone/fax/email
Peter Ateba	Sandwell Consulting Engineers Ltd.	c/o Andres Wines Ltd. P.O. Box 10550 Winona, Ontario L8E 5S4	Ph: (905) 643-4131 ext 2342 Fax: (905) 643-4481
Belinda Elysee-Collen	St. Lawrence Starch	141 Lakeshore Rd. E. Mississauga Ontario L5G 1E8	Ph: (905) 274-3671, Ext. 276 Fax:Fax: (905)-271-1258Email: belinda_elysee-collen@cargill.com
Dave Delevante	Nacan Products Ltd	201 MacDonald Road Collingwood, Ontario L9Y 4J1	Ph: 705-445-1140 x232 Fax: 705-445-9402 dave.delevante@nstarch.com
Bob Fotheringham	Ontario Bean Producers	140 Raney Cres., London ON N6L 1C3	Ph: (519) 652-3566, Fax: (519) 652-9607 rfother@tcc.on.net
Hugh Fraser	OMAFRA Horticultural Research Institute of Ontario	Vineland Station, Ontario L0R 2E0	Ph: (905) 562-4147, Ext. 304 Fax: (905) 562-5933 hfraser@omafra.gov.on.ca
Frank Holmes	ITA, NRC, Dept. of Food Science	University of Guelph, Guelph, Ont., N1G 2W1	Ph: (519) 824-4120 Ext. 3877 Fax: (905)824-6631 frank.holmes@irap.nrc.ca
Susan Iler (seeking repalcement)	OntarioSoybean Growers Marketing	Board, P.O. Box 1199 Chatham, Ontario N7M 5L8,	Ph: (519) 352-7730 Fax: (519) 352-8983 siler@ciaccess.com
Diana Iwaniw	Sandwell Consulting Engineers	Suite 100, 1016B Sutton Drive, Burlington, Ontario L7L 6B8	Ph: 905-319-1666 Fax: 905-319-1801 Diwaniw@sandwell.com
Ian MacKinnon	Jamesway Incubator Co., Ltd.,	30 High Ridge Court, Cambridge, Ont., N1R 7L3	Ph: 519-624-4646, Fax: 519-624-5803 ianmack@jamesway.com
Allen Mannen	Guelph Food Technology Centre	88 McGilvray St., Guelph, ONTARIO, N1G 2W1	Ph: (519) 821-1246(Ext.5037) Fax: (519) 836-1281 amannen@gftc.ca
Gauri S. Mittal (Past Chair)	School of Engineering,	University of Guelph Guelph, Ontario N1G 2W1	Ph: (519) 824-4120 ext. 2431 Fax: (519) 836-0227 gmittal@uoguelph.ca
Punidadas Piyasena (Chair)	Food Research Program, Agric. & Agric-Food Canada	95 Stone Road West, Box 3650, Guelph, ON N1H 8J7	Ph: (519) 829-2400 Ext. 3147 Fax: (519) 829-2600 piyasenaP@em.agr.ca
Simpson Pao	Dare Foods		Ph: 905-875-1223 Ext 301 Fax: 905-875-2524 Email: apao@darefoods.com
Albert Verbeem	Nestle Foodservices	P.O. Box 1800, Douglas Road, Trenton, Ontario, K8V 5S7	Ph: (613) 394-3328 Ext 274 Fax: (613) 394-4712 al.verbeem@ca.nestle.com
Ivan Vulicevic	Baeckerhaus Veit Ltd	70 Whitmore Road, Woodbridge Ontario, L4L 7Z4	Ph: (905) 850-9229 Ext. 35, Fax (905) 850-9292 Email:ivan@backerhausveit.com

Ping F. Wu	Ansatec	8 Silas Hill Drive, North York, Ontario, M2J 2X9	Ph: (416) 726-6298 Fax (416) 490-6659 Email: pingwu@ansatec.com
	OMAFRA	1 Stone Road West, Guelph, ON N1G 4Y2	Ph: (519) 826-4363 Fax: (519) 826-4375 EMail:ping.wu@omafra.gov.on.ca

ONTARIO LIVESTOCK ENGINEERING

RESEARCH AND SERVICES COMMITTEE

2001 ANNUAL REPORT
TO

ONTARIO AGRICULTURE AND FOOD

ENGINEERING

RESEARCH AND SERVICES COMMITTEE

DECEMBER 6, 2001

TABLE OF CONTENTS

Page

1.0 EXECUTIVE SUMMARY 3

1.1 PRIORITIES:
- Development of Standards for the Construction of Manure Storage Structures and Manure Handling Systems
- Integrity of Large Roof Systems
- Air Quality in Livestock Buildings
- Corrosion and Deterioration of Agricultural Building Components

2.0 INTRODUCTION 4

3.0 INDUSTRY/SECTOR SCAN
- Major accomplishments since last report 6
- Current State of the Industry 7
- Emerging Issues 9

4.0 STRATEGIC DIRECTIONS/PROBLEMS OR ISSUES/SECTOR PRIORITY 10

5.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS 16

APPENDICES

I Sub-Committee Membership 17

II Complete Listing Of Livestock Engineering Research And Services Needs 18

Proposed Livestock Engineering Sub-Committee Membership 22

1.0 EXECUTIVE SUMMARY

The Livestock Engineering Sub-Committee of the Ontario Agriculture and Food Engineering Research and Services Committee has listed the research and service needs of Ontario for 2001.

The following items require a high priority:

1. **Development of Standards for the Construction of Manure Storage Structures and Manure Handling Systems:** Integrity of manure storage and handling systems continues to be a high priority. Ideally, the National Farm Building Code needs to be revised to make manure handling and storage system integrity a requirement. Full scale testing is needed to assess current construction techniques and their ability to produce leakproof manure storage structures and transfer systems.

2. **Integrity of Large Roof Systems:** The snowfall experienced in the winter of 2000/01 caused partial roof collapse in approximately 14 large, newer swine buildings and in many older, deteriorated buildings. Since, in most cases, design snow loading was not reached, an industry-wide re-evaluation is currently taking place. The key to solving this problem is to ensure that appropriate engineering and inspection takes place. The roof truss industry and a group of consulting engineers have taken leadership in attempting to address these issues. Because of human safety issues, this work has a high priority

3. **Air Quality in Livestock Buildings**: Manure odours and gases, dust and dirt, and noise all contribute to the negative perception of air quality in livestock barns for both the animals and the farm workers. Existence of poor air quality is substantiated by the excessively high levels of chronic respiratory problems observed in farm workers. Poor air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. Unfortunately, these gases can develop very quickly or go unnoticed until it is too late. Losses of farm animals (particularily swine) continue to occur all too often. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

4. **Corrosion and Deterioration of Agricultural Building Components**: Steel reinforcing in silos, manure tanks and slats, as well as corrosion and deterioration of other building components can cause injury or loss of human life and livestock fatalities as well. This item includes buildings that enclose high humidity and corrosive environments (eg. composting operations). Ultimately, the National Farm Building Code may specify situations where specialized materials or coatings should be used. It is important to form partnerships with industry to fund and carry out this research.

2.0 INTRODUCTION

This report is a summary of the discussions held by our sub-committee, on October 10, 2001, Fred Groenestege Construction Boardroom, Sebringville, ON. At that time current research was reviewed, new areas of concern were noted and a listing of research and service needs in the livestock engineering area were organized.

SUB-COMMITTEE ACTIVITIES:

Activities: During the past year, we have had one meeting of this sub-committee. Attending this meeting were: Members: John Johnson (Chair/Sec.), Fred Groenestege, Jan Jofriet and Dr. Neil Anderson. Guests Harold House (OMAFRA) and Michael Hensen (Soprema Canada). Other members and Paul Brine were not able to attend due to other commitments.

Committee Membership:

Dr. Neil Anderson felt that, in response to comments from one member, he would not need to continue participating in this committee. It was suggested that animal care issues would take a back seat to structural issues experienced in the past year or so. Engineering issues impacting on animal care will remain a part of this committee. The chair was remiss in assuring Neil that his presence was needed, however this was conveyed to him at a later time. Several names have been suggested as possible future members for this committee. They included; David Waud (Sun-North Systems), Ray Jacobs (Landmark Builders Ltd.), Ron MacDonald (Agviro Inc.). Fred Groenestege is scheduled to leave our committee this year. Jim Cooke who has been scheduled to leave our committee for several years, will continue to participate, for one more year. It is important for the chair to encourage new membership so that a broad range of livestock engineering issues continue to be addressed.

Review of Current Listing:

At our subcommittee meeting, the following items were discussed:

Construction Concerns with Manure Storage – Continued discussion was held about the need for the entire manure handling system including the plumbing connections to be leakproof. The proposed Nutrient Management Act will make it necessary to pursue this though an emergency amendment to the Ontario Building Code. Currently, section 2.2.1.13 of the National Farm Building Code only discusses the construction of manure tank walls and tops. In October 2001, John Johnson forwarded a change request to the Standing Committee on Structural Design, NBCC. No response has been received by this date.

Corrosion of Truss Gusset Plates - In November 1997 our committee requested a new clause be added to the National Farm Building Code requiring all metal truss gusset plates to be protected by a suitable coating when used in a corrosive atmosphere. In April 1998 the Standing Committee on Structural Design replied that the matter warranted some action but required a more specific and enforceable proposal. The letter from the Code committee suggested that the Truss plate Institute of Canada be consulted to ensure that any proposed solution is achievable by the industry. In October 2001, John Johnson forwarded a change request to the Standing Committee on Structural Design, NBCC. No response has been received by this date.

Animal Comfort, Care, Health/Disease - This is a reiteration of the comments of last year's meeting where Jim Cooke felt that we should reduce the priority of this item. Jim asked John Johnson to contact Dr. David Price, New Mexico who has done much research in this topic area. Dr. Price feels that subtherapeutic use of antibiotics is not as large a concern as was previously stated. He feels that small doses of antibiotic will allow some naturally resistant organisms to exist, whereas massive doses of antibiotics will kill all non-resistant organisms, leaving only the resistant organisms. This resulted in the rewrite of this particular item in our listing.

Integrity of Large Roof Systems - The winter of 2000/01 proved to be a difficult one for large swine buildings in various provinces. In Ontario approximately 14 similar buildings suffered partial roof collapse. As well many older, deteriorated buildings collapsed or were damaged by the snow loading. In most cases, design snow loading was not reached. This leads us to conclude that there were shortcomings in the installation of the roof trusses. As a result, an industry-wide re-evaluation must take place. Items that must be considered: Who is ultimately responsible for the roof design? What design role does the roof truss engineer and supplier play in the process? A new proposal has been set out. Lateral bracing of compression web members (and the lack of a corresponding tie-off) is one of the major factors in the collapses experienced last winter. A task force has been looking into new methods of calculating roof loading as prescribed in the National Building Code. The roof truss industry and a group of consulting engineers have taken leadership in attempting to address these issues.

3.0 INDUSTRY/SECTOR SCAN:

Major Accomplishments since last report:

Air Quality in Livestock Buildings:

- air quality in livestock buildings (Univ. of Saskatchewan - 0.1 py (person years))
- evaluation of floor applied mineral oil in reducing respiratory dust (Univ. of Alberta - 0.1 py)

Corrosion and Deterioration of Agricultural Building Components:

- corrosion and deterioration of agricultural building components (Univ. of Guelph 0.35 py)

Manure tank design:

- Innovative design of manure storage tanks (Univ. of Manitoba - 0.54 py)
- A letter to the Standing Committee on Structural Design pertaining to the wording of the National Farm Building Code has been forwarded to the Standing Committee on Structural Design, NBCC in October 2001. In the interim, an emergency amendment to the Ontario Building Code is proposed.
- The proposed Nutrient Management Act requires the preparation of a comprehensive set of standards for all aspects involving the integrity of manure storage and transfer systems. Work is currently in progress.

Animal Comfort:

- A behavioural and environmental study to develop improved gestation and farrowing accommodation for sows and litters (Lennoxville, Que - 2.0 py)
- Using natural convection to lower attic temperatures in controlled environment buildings (Univ. of Manitoba - 0.08 py)
- Low Energy Input Swine Housing Systems (Winnipeg, Manitoba - time unknown)

Corrosion of Roof Truss Gusset Plates - A proposal has been re-submitted to the Standing Committee on Structural Design, NBCC in October 2001.

Technical Information for the Construction Industry:

- Structural behaviour of nail-laminated posts (Univ. of Manitoba - 0.11 py)
- Several meetings have been organized and presented to the farm building industry, the roof truss industry and consulting engineers across Ontario, pertaining to the roof collapses experienced in the winter of 2000/01

4.0 CURRENT STATE OF THE INDUSTRY/RURAL SECTOR:

Beef:
- the Ontario beef industry is moving into a time of optimism and growth. The industry is consolidating and being directed by stronger hands. The Ontario Cattle Feeders Association (approx. 3 years old) is showing a marked effect on the industry.
- much of the cattle feeding is done on contract

Dairy:
- optimism in the industry remains
- the price of quota continues to rise – variable, but averaging $20,000/kg of butterfat
- barns continue to be constructed, both by immigrant producers, and established producers
- Commercial robotic milking installations are becoming more common. A dozen or more farms are now operating exclusively with milking robots. Several companies are offering robots for sale: Lely, Prolion, Delaval, and Surge-Westfalia.

Swine:
- barns continue to get bigger in size: 2400 sow barns and 2000 finishing barns are becoming the norm
- society's reaction to proposed swine barns being built is becoming widespread.
- municipalities are reacting with restrictive by-laws in an attempt to minimize 'large' barns
- facilities with leaking manure tanks and manure transfer piping systems have been encountered.

Sheep and Goats:
- sheep production is increasing slightly, some as milking herds
- there is a continued increased interest in goat operations.

Poultry:
- producers continue to be very optimistic about this industry and seem prepared to invest big dollars in quota and new facilities. Interest continues to come from older dairy farmers who are switching between the two quota systems. Extremely high quota prices continue (broilers @ $42/unit; egg quota @ $80+/hen; turkeys @ $2.60/kg).
- Ontario has approximately: 1100 broiler producers; 200 pullet producers; 500 egg laying hen producers; and 160 turkey producers.

Fruit and Vegetables:
- the greenhouse industry continues to expand, particularly in the Leamington area (cucumbers and tomatoes) and in Niagara (flowers)
- non-traditional niche-market crops are being grown with unfamiliar post-harvest requirements

Grains and Forages:
- construction of tower silos remains at an all time low
- silo deterioration continues to be an ongoing challenge
- plastic from wraps, tubes, individual bags, etc. present local problems for recycling or disposal

Building Engineering:

- snow loading concerns have surfaced in large farm buildings. Recent collapse of up to 14 large buildings has sparked interest in the design process used for farm roofs.
- building construction is still relatively active in Ontario. Typically, new livestock buildings are tending to be very large. Engineering is more prevalent in these larger structures. A larger contractor may have an on-staff engineer or may hire a private consultant to provide engineering details. Building officials are happy to share some of the responsibility for the structure with an engineer.
- municipal restructuring means fewer, better trained building officials. There are currently less than 500 municipal building officials serving rural areas. It is expected that there will be approximately 350 by 2003. This is bringing about more even application of building codes in Ontario. OMAFRA continues its education program, directed toward the improved application of building codes in Ontario.

Environmental:

- A large number of swine, poultry and dairy operations are still being constructed in Ontario. Nutrient Management Plans are commonly being required by municipalities. Farmers are awaiting the final enactment of the proposed Nutrient Management Act. Public interest groups are becoming much more vocal against large livestock operations being constructed in their communities. Some municipalities have placed an interim control bylaw in effect to limit the construction of larger livestock operations until the Nutrient Management Act is finally enacted.

5.0 EMERGING ISSUES:

- the use of safety railings around openings in buildings and manure tanks and transfer pumps need to be addressed
- recent building collapses due to significant snow loading has resulted in the need to reconsider design methodology for farm roof construction.
- preventing manure leakage from barns and storages
- manure handling problems when sand bedding is used in free-stalls
- lower cost, covered manure storages for poultry
- more cold storages will be used year round to spread out costs. This may create some vapour barrier problems with reversing vapour pressure gradients
- need for improved aeration systems for flat grain storages
- producers believe there is a need for research to provide information and technology to prevent or alleviate concerns regarding animal welfare and environmental sustainability in all sectors.
- questions still remain regarding the use/operation of tunnel ventilation systems
- time commitment, and type of cleaning equipment being recommended for cleaning barns between animal cycles. There is some speculation on the use of robotics for this task

New Ideas for Research and Service:

- Require full-scale building testing of manure storage and handling components to prove or disprove the integrity of current building techniques
- Require development of comprehensive standards for all aspects of manure storage and handling
- Require an improved, comprehensive design model to describe snow load distribution on large farm structures
- Investigate the use of a spray bar to reduce H_2S development in tanker or manure tank
- Require information regarding the factors that affect tunnel ventilation
- Require increased odour control research for both inside barn air quality as well as around the buildings
- beef producers need to be able to lower costs of production by 20%. Simplified structures would assist. Some features might be modular construction, a roll-off roof, combination manure systems

STRATEGIC DIRECTIONS/PROBLEMS OR ISSUES/SECTOR PRIORITIES

RECOMMENDATION NUMBER: 1

ISSUE: Development of Standards for the Construction of Manure Storage Structures and Manure Handling Systems

SOURCE: Livestock Engineering Sub-committee

OASCC LINKAGES: Animal Committee

TARGET AGENCY:
Agricultural Research Institute Of Ontario,
Canadian Agricultural Research Council
Ontario Ministry of Agriculture, Food & Rural Affairs
Standing Committee on Structural Design, NBCC

Details: The proposed new Nutrient Management Act will require the development of appropriate standards to ensure that manure storage and handling systems have a high level of integrity

Research is needed:

5. To assess current construction techniques and to verify the integrity of the manure storage system in a full scale building test.

Applied Research is needed:

6. To develop standards for all types of manure storage, liners, transfer piping, etc.
7. To develop inspection protocols to ensure a uniform and appropriate level integrity.
8. Changes to the National Farm Building Code are necessary to ensure that all components of the manure storage and handling system are regulated.

Background: Issues related to integrity of manure storage and transfer plumbing have been encountered in the past several years. We need to know if shrinkage cracking in concrete floors and walls will allow the passage of manure in significant quantity. As well, construction joints need to be evaluated for their ability to protect against manure leakage. A full-scale project, utilizing a newly constructed livestock facility would provide much needed data to assist us in determining the integrity of current construction methods.

Cost/Benefit: It is estimated that the research needed to address these concerns could potentially cost approximately $100,000. Since it is difficult to put a price on clean water, it is safe to say that research dollars spent on this item would be well placed.

Resources: Ontario Pork, OMAFRA and the University of Guelph are committed to further research. OMAFRA is currently involved in the preparation of standards for components of manure storage and handling systems.

STRATEGIC DIRECTIONS/PROBLEMS OR ISSUES/SECTOR PRIORITIES

RECOMMENDATION NUMBER: 2

ISSUE: Integrity of Large Roof Systems

SOURCE: Livestock Engineering Sub-committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food & Rural Affairs
Standing Committee on Structural Design, NBCC

Details: Responsibility for the design and inspection of large roof systems has been misinterpreted and has not received uniform application across Ontario. It is important to establish acceptable protocols and to ensure that a proper education process is developed.

Applied Research is needed:

5. To develop appropriate design parameters for very large livestock structures that are becoming very common.
6. To make recommendations to the Standing Committee on Structural Design, NBCC regarding roof design for agricultural structures.
7. To develop inspection protocols to ensure a uniform and appropriate level of safety.
8. To carry out a province-wide education/awareness program.

Background: The winter of 2000/01 proved to be a difficult one for large swine buildings in various provinces. In Ontario approximately 14 similar buildings suffered partial roof collapse. As well many older, deteriorated buildings collapsed or were damaged by the snow loading. In most cases, design snow loading was not reached. This leads us to conclude that there were shortcomings in the installation of the roof trusses. Items that must be considered: Who is ultimately responsible for the roof design? What design role does the roof truss engineer and supplier play in the process? A new proposal has been set out. Lateral bracing of compression web members (and the lack of a corresponding tie-off) is one of the major factors in the collapses experienced last winter. A task force has been looking into new methods of calculating roof loading as prescribed in the National Building Code. The roof truss industry and a group of consulting engineers have taken leadership in attempting to address these issues.

Cost/Benefit: This is a service oriented task. It is estimated that the cost of establishing design guidelines is relatively small, considering the donation of time from all participants. An estimate of cost to the industry is $50000. The cost of structural damage and lost production, considering only the 14 relatively new buildings is measured in the millions of dollars. Rate of payback is very high.

Resources: OMAFRA, the Ontario Wood Truss Fabricators Association, the Canadian Truss Plate Institute and a group of consulting engineers are working to establish a protocol for the design of these large roof systems

RECOMMENDATION NUMBER: 3

ISSUE: Air Quality in Livestock Buildings

SOURCE: Livestock Engineering Sub-Committee

OASCC LINKAGES: Animal Committee, Soil Water and Air Committee

TARGET AGENCY: Agricultural Research Institute Of Ontario
Canadian Agricultural Research Council
Agriculture & Agri-Food Canada

AIR QUALITY IN LIVESTOCK BUILDINGS

Details: Manure odours and gases, dust and dirt, and noise all contribute to poor air quality in livestock barns for both the animals and the farm workers. Poor air quality has been verified by the excessively high levels of chronic respiratory problems observed in farm workers. Air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

Research is Needed:

1. To study means of reducing the level of air contaminants found in barn environments.
2. To develop improved manure storage systems and management, handling, processing and disposal to reduce hazardous gas generation and minimize odour problems.
3. To determine the chronic effects of sub-lethal gas levels on both humans and livestock and evaluate the long term effects of exposure to these hazardous gases.
4. To determine the short and long term effects of barn noise on both humans and livestock.

Applied Research is Needed:

5. To agree on practical and achievable Threshold Limit Values (TLV) for the various air pollutants and combinations of same encountered inside farm buildings.
6. To measure the effect of various additives to the barn environment, feed or manure gutters on subsequent air quality and odour control.
7. To study under-floor ventilation with regard to improved odour control in the animal environment.
8. To develop a thorough evaluation and testing program for warning devices which alert farm personnel that one of the hazardous gases is at a dangerous level.
9. To develop appropriate and practical information for dealing with hazardous gases found at dangerous levels in the animal environment or feed storage area.

Background: Work is still required to develop appropriate strategies for dealing with the various air pollutants, odours and noise levels found in livestock barns. Today's farm workers spend most of their time inside livestock buildings, feed and grain storages as well as operating noisy machinery. They are exposed to high concentrations of different organic dusts such as grain dust, animal epithelia, hair, proteins from urine and feces, mites, bacteria, endotoxin and mold spores. Also, these particles are associated with various toxic gases such as ammonia, hydrogen sulphide, carbon monoxide, etc.

Several of these toxic gases are either odourless or have the ability to paralyse the nervous system and thus are hard to detect when present at harmful concentrations. As farming operations become larger, more hired labour is employed and this increases the chance of short-cuts or misunderstood safety procedures. With several gases involved, more than one warning device may be needed to cover all of the needs of a particular environment. Any such warning device must be reliable over time when located in such a harsh building environment. This type of gas sampling equipment already exists but needs to be evaluated and/or adapted to suit the specific needs of animal environments. Cost will be an important factor in convincing farmers to install these devices. Many producers inquire about chemical additives to the feed, water or manure storage which might reduce odours and toxic gases. Some work is being done by Agriculture Canada, Ridgetown Agricultural College, University of Saskatchewan and Iowa State University, however much is still unknown about the effectiveness of these additives. There may be opportunities for gas and odour reduction within the animal environment with alternative manure handling, processing and disposal systems. There is no known work in this area.

Cost/Benefit: From research work done in Europe and the USA, it has been estimated that 25% to 40% of all the livestock producers and their family members, as well as their farm workers suffer to varying degrees from bronchitis, occupational asthma, organic dust toxic syndrome or general irritation of mucosal membranes due to the poor air quality inside livestock buildings. Applying this estimate to Ontario, there would be between 30,000 and 50,000 people suffering from poor indoor air quality on dairy, beef, swine and poultry farms. It is extremely difficult to evaluate the cost to society because of a reduction of productivity by workers' absenteeism and medical care services directly related to barn air quality. Additionally, it is impossible to assess the cost or loss of revenue encountered by producers because of the difficulty in recruiting, training and maintaining reliable farm workers.

The presence of toxic gases is a human and animal safety issue that is difficult to quantify in dollars. If some animals are killed due to exposure to H_2S gas, not only is there the direct animal losses, but also the down time while another group of animals is raised on farm or purchased to replace those lost. Manure gas, silo gas and carbon dioxide (sealed silo) have all claimed human lives on farms. What is the value of a human life? If a simple gas detector could be marketed for a reasonable cost, along with a proven procedure for reducing hazardous gas levels, it would significantly reduce the number of animal and human respiratory injuries and possible fatalities.

Resources: The University of Guelph, Prairie Swine Research Centre, University of Alberta and University of Saskatchewan have all done some work with air pollutants in livestock buildings but much more work is required. An interdisciplinary task force of agricultural engineers, researchers, veterinarians, physicians and occupational health specialists should be assembled to address threshold limit values for indoor air contaminants, odours and noise levels in farm buildings.

Both Agriculture Canada and OMAFRA have done some research and extension in the areas of manure and silo gas. As well, the University of Guelph, OMAFRA, Prairie Swine Research Centre and the University of Saskatchewan have all done some studies on air contaminants and dust in livestock environments. More needs to be done with commercial scientific instrument companies that already market gas detection equipment. Similarly, it may be possible to co-operate with chemical or feed companies regarding the potential for additives.

RECOMMENDATION NUMBER: 4

ISSUE: Corrosion of Metal Building Components

SOURCE: Livestock Engineering Sub-Committee

OASCC LINKAGES: Animal Committee, Horticultural Crop Committee

TARGET AGENCY: Agricultural Research Institute Of Ontario,
Canadian Agricultural Research Council
Agriculture & Agri-Food Canada
Standing Committee on Structural Design, NBCC

CORROSION AND DETERIORATION OF AGRICULTURAL BUILDING COMPONENTS

Details: Corrosion problems are evident in some farm structures that could affect their structural integrity. Reinforcing steel in cast-in-place silos and beef and swine floor slats have shown deterioration which could lead to structural failure. In under-floor manure storage structures, manure gas and other air contaminants are accelerating the corrosion and deterioration of all metal components and building equipment. Composting structures are showing corrosion on unprotected metal components after a relatively short time. Also, it appears that some wood preservatives hasten corrosion of the structural fasteners used to connect building members.

Research is Needed:

1. To study the relationship between various odours and gases and moisture levels found in typical livestock environments (also composting structures) and the amount of corrosion occurring on the metal building components.
2. To determine the relationship between various wood preservatives and the amount of corrosion occurring on the metal fasteners connecting these members in a farm building.
3. a) To determine the feasibility of using a steel coating and/or concrete additives to inhibit the corrosion of reinforcing steel in such adverse situations as slatted floors, silos and manure storage.
   b) To determine the feasibility of using concrete sealants and coatings that may reduce concrete deterioration which in turn will protect the reinforcing steel.

Background: Silage juices and liquid manure are able to attack the concrete and over time penetrate to the reinforcing steel which in turn corrodes very quickly. The agricultural industry needs a more durable concrete product. Should coated reinforcing bars, concrete additives, coatings and sealants be used, alone or in combination? Concrete slat deterioration has become a significant problem.

The combination of various gases along with higher humidity levels found in livestock barns tend to corrode all metal components of the building and equipment. Proper ventilation plays a role, but to what extent? A field study by OMAFRA revealed that almost half of the livestock buildings investigated had moderate to severe corrosion occurring on the metal gusset plates.

Wood preservatives have been used with good success to protect the building members from deterioration. Concern has now been raised that some preservatives seem to cause an accelerated corrosion of the metal fasteners connecting these treated members in a typical farm building. The farm building industry needs to know which preservatives should be recommended or whether the fasteners need to be coated to prevent this corrosion process.

Cost/Benefit: In 1994, the cost of depreciation on all Ontario agricultural structures was $234.2 million. As well, $130.24 million was spent on building repairs. Since agricultural structures may need to be repaired or replaced prematurely because of this deterioration, these costs could be substantial. On average, corrosion could account for a 10% loss of expected building life. It is estimated that the value of Ontario farm buildings is $10 billion and the average life expectancy of a farm building is 25 years. As a result of corrosion, if the building lasts for only 22.5 years, this results in an annual cost of $44 million.

Livestock housing costs account for 10-20% of the total cost of production. Any shortening of the service life will increase these costs. In addition, if there is a structural failure, there may be additional financial hardship and potential for both human and animal injury or fatality. It is unlikely that any research recommendations concerning suitable coatings, sealants or concrete additives would increase overall building construction costs by more than 5%. If the value of agricultural structures in Ontario is $10 billion, and their life is 22.5 years, approximately $444 million is spent on new construction annually. If the cost to resist corrosion in these structures is 5 percent, this would amount to an annual cost of $22 million.

Therefore the cost/benefit ratio is 22/44 = 1:2

Resources: O.M.A.F.R.A. has evaluated several coatings for use on concrete silo walls. All Ontario concrete slat manufacturing plants are now certified by CSA which should ensure a quality slat for all new buildings. Concrete slat manufacturers are promoting several different approaches to providing increased durability. It is important for cooperative research to take place with these manufacturers. Additionally, the steel industry has good data available on coated reinforcing steel and may wish to collaborate on this type of work. Similarly, the steel industry should expect to work with researchers and the chemical industry to establish recommendations concerning the use of various coatings on metal components in corrosive environments.

SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS FOR 2001

RESEARCH AND DEVELOPMENT:

To Agency(ies)

Recommendation	AAFC	ARIO	CC	CARC	OMAFRA	OTHER
5.Development of Standards for the Construction of Manure Storage Structures and Manure Handling Systems		X	X	X	X	*NFBC
6.Integrity of Large Roof Systems					X	*NFBC
7.Air quality in livestock buildings	X	X	X	X		
8.Corrosion And Deterioration Of Agricultural Building Components	X	X	X	X		*NFBC

*National Farm Building Code for Canada (Standing Committee on Structural Design, NBCC)

APPENDIX II Subcommittee Membership 2001
(please see proposed list for 2002 at end of document)

Organization	Name	Contact Information	Term End
OMAFRA	**John Johnson** (Chair)	OMAFRA, 667 Exeter Rd. LONDON, ON N6E 1L3 Ph. 519-873-4096 Fax 519-873-4062 john.johnson@omafra.gov.on.ca	**Passed expiry** date
Univ. of Guelph	Dr. Jan Jofriet	University of Guelph, School of Engineering, GUELPH, ON NIG 2WI Ph. 519-824-4120 Ext. 3642 Fax 519-836-0227 jjofriet@uoguelph.ca	2002
Private Sector	Jim Cooke	R.R.#1 Walkerton, ON N0G 2V0 Ph. 519-881-1188 Fax 519-881-3628 redbaron@bmts.com	2002
Private Sector	Fred Groenestege	Fred Groenestege Const. Ltd. R.R.#1, SEBRINGVILLE, ON N0K 1X0 Ph. 519-393-6579 Fax 519-393-6532 fredg@fgc.ca	2001
OMAFRA	Dr. Neil Anderson	OMAFRA 2nd Floor, Wellington Place, R.R.#1 FERGUS, ON N1M 2W3 519-846-0965 Fax 519-846-8101 neil.anderso@omafra.gov.on.ca	2001
Private Sector	Dale Thompson	BSM Farm Equipment	2003
Shur-Gain Agresearch	Bob Robson	R.R.#3, Burford, ON N0E 1A0 Ph. 519-424-2550 Fax 519-424-2570 shurgain@oxford.net	2002

2001 COMPLETE LIST OF LIVESTOCK ENGINEERING RESEARCH AND SERVICE NEEDS (in order of priority)

1) DEVELOPMENT OF STANDARDS FOR THE CONSTRUCTION OF MANURE STORAGE STRUCTURES AND MANURE HANDLING SYSTEMS

Techniques used in the construction of manure storage structures, transfer piping, etc. have been found in some situations to be lacking quality of workmanship. The proposed new Nutrient Management Act will require that appropriate standards be developed to ensure that construction quality is high.

Research is needed:

1.To assess current construction techniques and to verify the integrity of the manure storage system in a full scale building test.

Applied Research is needed:

2.To develop standards for steel, concrete, earthen storages, synthetic and clay liners, transfer piping, etc.
3.To develop protocols that will ensure a uniform and appropriate level of building inspection.
4.Changes to the National Farm Building Code are necessary to ensure that all components of the manure storage and handling system are regulated.

*****

2. INTEGRITY OF LARGE ROOF SYSTEMS

Responsibility for the design and inspection of large roof systems has been misinterpreted and has not received uniform application across Ontario. It is important to establish acceptable protocols and to ensure that a proper education process is developed.

Applied Research is needed:

1.To develop appropriate design parameters for very large livestock structures that are becoming very common.
2.To make recommendations to the Standing Committee on Structural Design, NBCC regarding roof design for agricultural structures.
3.To develop inspection protocols to ensure a uniform and appropriate level of safety.
4.To carry out a province-wide education/awareness program.

*****

3.AIR QUALITY IN LIVESTOCK BUILDINGS

Manure odours and gases, dust and dirt, and noise all contribute to poor air quality in livestock barns for both the animals and the farm workers. Poor air quality has been verified by the excessively high levels of chronic respiratory problems observed in farm workers. Air quality is one of the main causes of high labour turn over on livestock farms. Hazardous gases, including silo gas, hydrogen sulphide gas and carbon dioxide have on occasion accumulated to toxic levels and caused fatalities to humans and/or farm animals. It is also expected that there are numerous cases of injuries to the lungs of both humans and animals from sub-lethal levels of these noxious gases.

Research is Needed:

1. To study means of reducing the level of air contaminants found in barn environments.
2. To develop improved manure storage systems and management, handling, processing and disposal to reduce hazardous gas generation and minimise odour problems.
3. To determine the chronic effects of sub-lethal gas levels on both humans and livestock and to evaluate the long-term effects of exposure to these hazardous gases.
4. To determine the short and long term effects of barn noise on both humans and livestock.

Applied Research is Needed:

5. To agree on practical and achievable Threshold Limit Values (TLV) for the various air pollutants and combinations of same encountered inside farm buildings.
6. To measure the effect of various additives to the barn environment, feed or manure gutters on subsequent air quality and odour control.
7. To study under-floor ventilation with regard to improved odour control in the animal environment.
8. To develop a thorough evaluation and testing program for warning devices which alert farm personnel that one of the hazardous gases is at a dangerous level.
9. To develop appropriate and practical information for dealing with hazardous gases found at dangerous levels in the animal environment or feed storage area.

*****

4.CORROSION AND DETERIORATION OF AGRICULTURAL BUILDING COMPONENTS

Corrosion problems are evident in some farm structures that could affect their structural integrity. Reinforcing steel in cast-in-place silos and beef and swine floor slats have shown deterioration which could lead to structural failure. In under-floor manure storage structures, manure gas and other air contaminants are accelerating the corrosion and deterioration of all metal components and building equipment. Composting structures are showing corrosion on unprotected metal components after a relatively short time. Also, it appears that some wood preservatives hasten corrosion of the structural fasteners used to connect building members.

Research is Needed:

1. To study the relationship between various odours and gases and moisture levels found in typical livestock environments (also composting structures) and the amount of corrosion occurring on the metal building components.
2. To determine the relationship between various wood preservatives and the amount of corrosion occurring on the metal fasteners connecting these members in a farm building.
3. a) To determine the feasibility of using a steel coating and/or concrete additives to

inhibit the corrosion of reinforcing steel in such adverse situations as slatted floors, silos and manure storage.

b) To determine the feasibility of using concrete sealants and coatings that may reduce concrete deterioration which in turn will protect the reinforcing steel.

*****

5.LIVE STOCK BUILDING DESIGN, CONSTRUCTION and HUSBANDRY SYSTEMS RELATIONSHIP TO HUMAN HEALTH ENHANCEMENTS (workplace)

Livestock producers should know what renovations to existing buildings, or changes to new animal housing would enhance livestock immunity, and would improve working conditions for workers within the facility.

Research is needed:

1. To identify the design, construction and husbandry systems in livestock buildings that compliment high livestock health and performance.
2. To identify the design, construction and husbandry systems that contribute to disease and impaired performance.
3. To develop practical and economical modifications to existing husbandry systems or create new husbandry systems within livestock buildings to enable high livestock health and performance.
4. To identify design, construction and husbandry systems that minimize disease transmission. (Conversely, to identify design, construction and husbandry systems that contribute to the spread of infectious diseases.)
5. To look at the feasibility of creating a centre for livestock husbandry planning to enable dialogue between scientists in the disciplines of engineering, waste management, nutrition, veterinary medicine, economics, and human medicine, directed at livestock housing systems, animal and human health, with the goal of enhancing animal and human health.

*****

6.ICE PRESSURES FOR MANURE TANK DESIGN

Based on the findings of field surveys in the winters of `94-`95 and `95-`96, OMAFRA standard designs for cylindrical tanks were redesigned for 0.2 m, 0.4 m and 0.6 m design ice thickness. After further consideration of the various climatological regions of Ontario recommendations will be made for use of one of these three designs.

Service is needed:

1. To publish the results of the ice build-up survey of manure tanks in Southern Ontario.
2. To publish design information that will assist concrete tank designers in Ontario.

*****

7. TECHNICAL INFORMATION TO ASSIST THE FARM BUILDING INDUSTRY

The Ontario Ministry of Agriculture, Food and Rural Affairs has agreed to assume the co-ordination role for the C.P.S. (Canada Plan Service). This will require an on-going effort to maintain the existing CPS data resources and support the development of new plans and technical leaflets. The farm construction industry requires technical information on several topics; chimney design for natural ventilation, diaphragm bracing for post frame construction, the use of laminated posts, and information regarding tunnel ventilation for combating animal heat stress. The industry has identified building construction/inspection as an area that needs improvement. In particular, building inspection across the province is not uniform and courses should be mandatory for building officials to assure their education level.

Service is required:

1. To support OMAFRA's effort to maintain the existing CPS data resources and promote the development of new plans and technical leaflets.
2. To write a Factsheet regarding wind forces on farm buildings.
3. To ensure that training/upgrading courses are available for building officials and building contractors so that uniformity of building construction/inspection takes place.

PROPOSED SUB-COMMITTEE MEMBERSHIP FOR 2002 LIVESTOCK ENGINEERING SUB-COMMITTEE

Organization	Name	Contact Information	Term End
OMAFRA	**John Johnson, P.Eng.** (Chair)	OMAFRA, 667 Exeter Rd. LONDON, ON N6E 1L3 Ph. 519-873-4096 Fax 519-873-4062	**Passed due**
Univ. of Guelph	Dr. Jan Jofriet, P.Eng.	University of Guelph, School of Engineering, GUELPH, ON NIG 2WI Ph. 519-824-4120 Ext. 3642 Fax 519-836-0227	2002
Private Sector	Jim Cooke, P.Eng.	R.R.#1 Walkerton, ON N0G 2V0 Ph. 519-881-1188 Fax 519-881-3628	2002
Private Sector	Mike Hensen, P.Eng. (invited as guest in 2001)	Soprema Canada 151 York St., Suite 12 London, ON N6A 1A8 Ph. 519-672-5561 Fax 519-672-1578	2005
OMAFRA	Harold House, P.Eng. (invited as guest in 2001)	OMAFRA, Box 159 Don St. Clinton, ON N0M 1L0 Ph. 519-482-1488 Fax 519-482-5031	2005
Shur-Gain Agresearch	Bob Robson	R.R.#3, Burford, ON N0E 1A0 Ph. 519-424-2550 Fax 519-424-2570	2002
Private Sector	Dale Thompson	BSM Farm Equipment	2003
Private Sector	David Waud, (invited as guest in 2002)	Sun North	2005
Private Sector	Ron MacDonald, P.Eng., (invited as guest in 2002)	Agviro Inc.	2005
Private Sector	Ray Jacobs (invited as guest in 2002)	Landmark Builders	2005

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

Report

TO

ONTARIO AGRICULTURAL AND FOOD ENGINEERING RESEARCH AND SERVICES COMMITTEE

December 6, 2001

TABLE OF CONTENTS

PAGE

1.0 EXECUTIVE SUMMARY 1

2.0 INTRODUCTION 3

3.0 SUBCOMMITTEE ACTIVITIES 4

4.0 STATE OF THE INDUSTRY 4

5.0 ACHIEVEMENTS 5

6.0 EMERGING NEEDS 6

7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS 9

8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS 10

9.0 DETAILED RECOMMENDATIONS 11

10.0 APPENDIX 22

LIST OF ACRONYMS

AAFC	Agriculture and Agri-Food Canada
ARIO	Agricultural Research Institute of Ontario
CARC	Canadian Agri-Food Research Council
CC	Canada Committees
CPS	Canada Plan Service
CURB	Clean Up Rural Beaches
EFP	Environmental Farm Plan
LICO	Land Improvement Contractors of Ontario
MCCR	Ministry of Consumer & Commercial Relations
MNR	Ministry of Natural Resources
MOE	**Ministry of Environment**
OAFERSC	Ontario Agricultural and Food Engineering Research and Services Committee
OFEC	Ontario Farm Environmental Coalition
OMAFRA	Ontario Ministry of Agriculture, Food, and Rural Affairs
UG-AC	University of Guelph Alfred College
UG-RC	University of Guelph Ridgetown College
SPOF	Strategic Plan for Ontario's Fisheries
SWEEP	Soil and Water Environmental Enhancement Program
UTRCA	Upper Thames River Conservation Authority

1.0 EXECUTIVE SUMMARY

The Rural Environment Engineering Subcommittee presents this minor report to the Ontario Agriculture and Food Engineering Research and Services Committee (OAFERSC). The committee recognizes the new procedures to be followed and also that this year the Plant Program is the major area of review. Issues related to Food Program are to be forwarded to the appropriate committee for consideration. The Rural Environment Engineering Subcommittee primarily focused on last years report and evaluated whether there were any new more pressing issues to address before the next major review and what the progress has been made on the research recommendations from the previous year.

Air and water quality (more specifically groundwater quality) and water quantity are the major issues to be addressed within the rural environment area. Increased pressure from the public and other government agencies is pushing the agricultural sector to continue to increase activity in the air and water quality areas from a research and technology transfer standpoint.

The following emerging needs were identified:

1) Municipal Nutrient Management and Interim Control Bylaws to Control Development of Large Livestock Operations
2) Community Resentment Towards the Establishment of Large Swine Operations
3) An accelerated Rise in Public Scrutiny, Interest, and Activity in ground water quality and contamination. Primarily is focused on bacteria but likely to progress to nitrates in the future.
4) Application of biosolids on agricultural land is receiving increased scrutiny with equal attention as livestock manure.
5) Large Water Systems regulations require well head studies which are likely to lead to well head protection plans and likely to be restrictive to some agricultural activities. Small Water Systems are under review as well and further regulations are being considered.
6) Municipal Waste Water Treatment Systems At Capacity and Looking at Less Costly Alternatives -Phosphorous Offset Methods.
7) Draught Conditions Have Passed but Discussions on Water Rights and Allocation Will Continue.
8) Greater demand for better weather forecasting and networking for better management of land application of manure and biosolids as well as for surface water supply management.
9) Drainage Looked at as Contributor to Low and High Flow Rates in Streams as well as water quality problems.
10) Methane - Greenhouse Gas from manure
11) Vegetable Wash Water Quality and Legislative Impacts
12) Livestock Access to Streams and Conflict with Fisheries Act
13) Irrigation Water Quality and Food Safety
14) Nutrient Management Plan Bylaw Court Challenges
15) Impacts of weather to runoff and infiltration.

Research recommendations were reviewed and adjusted to reflect research needs based on present conditions and emerging needs. The priority recommendations for research and services as identified by the Subcommittee are as follows:

(New 2001)

a) Investigate methods by which farmers can determine if manure is present in tile water and what benchmark standards are appropriate. (R & D)

This project involves developing techniques by which farmers can determine if manure is reaching tile water and at what levels. The technique must be quick and as simple as possible but attains reasonably accurate measurements. Standards must be identified and developed to support the testing procedure.

b) **Investigate environmental benefits of pasturing floodplain areas and identifying conditions under which the benefit may occur. (R & D)**

This project involves investigating the environmental benefits of floodplain alternatives as compared to other land use practices that might occur e.g. row cropping, land tillage etc. Criteria to determine where floodplain pasturing would be appropriate and what other conditions need to be in place.

(Previous recommendations from 2000)

1) To develop improved systems for applying manure to no-till, hay, and pasture land and sensitive areas such as ground water recharge zones and shallow topsoil over bedrock areas more accurately, cost effectively and environmentally safe. (R & D)

Research should be oriented towards developing techniques to accurately apply manure both solid and liquid in a cost effective and environmentally safe manner on known sensitive and high-risk areas. Nutrient management plans are requiring low rates of application and equipment is not available to accomplish the task. Also of great importance is to find techniques of applying liquid manure to tile drained land and without risk of manure reaching the drains through macropores.

2) To evaluate and quantify the impact of large livestock operations on the rural environment. (R & D)

A comprehensive study is required to evaluate and quantify the impact on the environment by large livestock operations. Items that must be studied are:

- volumes of water used and possible impacts on ground water supplies
- effects of concentration of livestock facilities in an area versus spot development
- do MDS formulas adequately assess odour potential of large livestock units
- odours from the buildings
- odours from the manure storage
- odours from spreading large volumes of manure
- impact of manure transport on public roads
- ability to handle large quantities of manure and the time required

3) To investigate and adapt alternative treatment process methods to reduce odours from livestock manure and make for a safer product to apply to the land. (R & D)

This project involves an examination of various manure treatment options with the specific goal of reducing odour levels at the barn and storage and to make the manure safer to land apply. It is especially aimed at liquid swine manure systems, though the suitability for other livestock types should also be considered. Treatment could occur during collection, during transfer to storage, during storage, or some combination. The feasibility of biofilters, mechanical systems, aeration, bacterial and enzyme methods etc. needs to be investigated. There are two phases of odour generation to investigate i) from the barn and ii) from the storage. Some of these technologies have been successfully applied to urban and industrial applications. There needs to be a concerted effort to apply these technologies to treatment of livestock manure.

4) To identify sources of microbiological and pathogen related water contamination in agricultural watersheds and put into perspective the various contributors. (R & D)

A comprehensive study is needed to examine all sources of microbiological and pathogen water contamination in agricultural watersheds and put into perspective the relative contributions of the various sources. There should be equal focus on surface and ground water quality. Key indicators would include: E. Coli bacteria, Cryptosporidium, giardia, and other related issues such as hormones, heavy metals, and antibiotics. Practices to consider would include:

a) farm practices such as: tillage, nutrient management, manure storage and spreading, livestock pasturing, crop rotation; and
b) non-farm practices such as road construction and maintenance, rural septic system use, municipal sewage treatment plant scheduled and unscheduled releases, other spills, wildlife, etc.

2.0 INTRODUCTION

This is the 2001 minor report of the Rural Environment Engineering Subcommittee to the Ontario Agriculture and Food Engineering Research and Services Committee (OAFERSC). This report highlights emerging needs and research recommendations in the rural environment area. As well, the services (non-research) recommendations were reviewed.

The committee's focus was on research and extension needs related to the rural environment (soil, water, and air). Issues were addressed from an engineering perspective recognizing that there will be some grey areas which may generate some similar recommendations from other committees especially with the present day pressures and interest related to large livestock operations. These crossover areas should not be looked upon as duplication, but rather as important issues recognized and pursued by two disciplines in a co-operative effort.

Information in this report was provided by subcommittee members representing Colleges of Agricultural Technology, University of Guelph, OMAFRA, and the private sector.

3.0 SUBCOMMITTEE ACTIVITIES

A meeting of the subcommittee members was held at the Ontario Ministry of Agriculture, Food, and Rural Affairs building in Guelph. The previous year's report was reviewed and updated. The University of Guelph Environmental program was reviewed last year making this years efforts primarily focused on reviewing the previous years recommendations and verifying that they were still appropriate to the needs of the time. Recommendations were reviewed and adjusted to meet the requirements of the present situation in the agricultural sector. Plants Program is the primary focus for this year in alignment with the U of G program reviews. Two new recommendations were added and are reported separately as noted in the report.

The views and consensus of the committee is reflected in this report. The majority of committee members were present.

4.0 STATE OF THE INDUSTRY

Soil, water, and air issues related to large livestock operations continue to dominate the agricultural industry. The primary stimulation is the construction of swine barns. The number of large swine and dairy operations are still on the increase . More and more municipalities are passing bylaws to try and control construction in an orderly fashion. Nutrient management plans, days of manure storage, and MDS II requirements are included in most bylaws. Interim control bylaws on large livestock building construction are common awaiting the proposed Agricultural Operations Act by the province. Variations occur when attempts are made to inventory land used for application of manure and guarantee application rates. Local resident organizations are still very vocal and well organized in presenting their concerns and demands. Municipalities are reacting accordingly.

Much attention is still focused on bacteria and nitrates as the primary contaminants in light of the Walkerton situation. Runoff from agricultural lands is being scrutinized from many fronts. Department of Fisheries and Oceans and Environment Canada are now getting involved more directly with situations that may be impacting fisheries in Ontario i.e. two incidents in Eastern Ontario where charges have been laid. Demands to protect and create riparian zones along waterways and wetlands is also still on the rise.

Phosphorous loading on streams is still a primary concern in many areas of the province. Many municipal treatment systems are dependent on rivers to assimilate treated wastewater from cities and towns. Assimilative capacities of some rivers have reached or are reaching the maximum levels permitted. Municipalities are searching for cost-effective alternatives such as "phosphorous trading" or "phosphorous credit" type accounting systems based on improvements to agricultural land and nutrient management techniques. Waterloo region has successfully implemented a financial incentive program in targeted areas to encourage implementation of BMP's in agricultural areas. Wellington County is nearing completion of its first year of a similar Rural Water Quality Program with the main difference that it is county based rather than a targeted watershed area. Other areas (Lake Simcoe, South Nations etc.) are in the process of also initiating similar programs. The problem still remains as to how to account for water quality improvements (phosphorous) which are hard to measure or take time to appear. Empirical and modeling methods are being developed for the purpose of accounting water quality gains.

The Environmental Farm Plan process went through its eighth full year of operation and distributed close to 2000 workbooks which is consistent with previous years. This program is in jeopardy as it is in its final year of funding and new sources of monies have not been secured. The committee recognizes this program as valuable and important for its accomplishments. Some way should be found for its continuation. The incentive program which provides $1500 towards improvements identified in the Farm Plan is being well used and on the increase. The Rural Water Quality Program in Waterloo implemented a completed Environmental Farm Plan as a requirement of eligibility for the program as has the Wellington County program.

Activity in the tile drainage industry

Activity in tile drainage installation is stable and similar to previous years.

The Department of Fisheries and Oceans, in consultation with stakeholders, has developed a Class Authorization system for the maintenance and repair of existing municipal drains. They, in partnership with local Conservation Authorities, have funded the collection of data to catalogue the fish habitat that currently exists in municipal drains. This information is used to classify each municipal drain into six different categories. As a result, municipal drainage superintendents will be able to receive a "class authorization" for their proposed work, provided they follow the predefined conditions for that drain. This positive development promises to minimize the frequent conflicts between municipalities and environmental agencies in the maintenance and repair of existing municipal drains.

5.0 ACHIEVEMENTS

.1 Publications, Factsheets, Manuals

.2 Educational Courses

Primary Drainage Contractors Course, Feb. 2001

Municipal Officials Drainage Course - Apr. 2001

Concrete Manure Storage Design Course, 2001

Custom Manure Application Course, 2001

Pollution Control Course, 2001

Drainage Superintendents Course, 2001

Nutrient Management Sessions - 2001 (several)

Ontario Environmental Farm Plan - 2001 All Ontario.

.3 Reports, Periodicals, Articles

.4 Other

6.0 EMERGING NEEDS

.10 Municipal Nutrient Management and Interim Control Bylaws to Control Development of Large Livestock Operations

Large livestock operations are still on the rise in Ontario. Municipalities are reacting to the concerns of the public at large as well as reacting to bylaws instituted in neighbouring municipalities with the view that if neighbouring bylaws are more restrictive swine barn will move to those areas with less control. Nutrient management plans are required in all the new bylaws along with MDS II and minimum storage requirements but that does not seem to be enough.

Other variables that are being introduced are inventory of land used for manure spreading, verification of application rate, size caps, minimum acreage owned, registration of land to be used for manure application etc. Municipalities are searching for mechanisms to give them more control over the situation. Municipalities are hopeful that the new proposed legislation will address many of the enforcement concerns that cannot be addressed with existing mechanisms.

.12 Community Resentment Towards the Establishment of Large Swine Operations

Resentment towards the construction of large swine producing facilities continues to escalate. Guarantees of no odours, no ground water contamination, and no surface water contamination are being demanded. Rural residents who may not even be adjacent to or near the construction sites get actively involved. Some situations are even proceeding through the courts to challenge the construction and operation of larger swine barns. Recent incidents related to leakage from manure storages into tile drains have "fuelled the fires" even further.

.13 An Accelerated Rise in Public Scrutiny, Interest and activity in Non-traditional Components of Water Pollution. Primarily is focused on pathogens but is likely to progress to nitrates in the future.

Water quantity and quality issues are stimulating people to become more aware of other types of water pollution such as Cryptosporidium, giardia, residual medicines and hormones etc. As their knowledge base increases so does their suspicions of what else might be out there that could be harmful and/or persistent. In many cases there is a link to agriculture. Nitrate has not been a focus of attention yet but is likely to be in the near future.

.14 Application of Biosolids on Agricultural Land is Receiving Increased Scrutiny with Equal Attention as Livestock Manure.

Biosolids application to farmland is being viewed with the same scrutiny as livestock manure. Public pressure is rising and likely to continue to increase for more monitoring and accountability. The existing Certificate of Approval is considered inadequate and insufficiently enforced. Conservation Authorities are requesting more data and information related to spreading sites information.

.15 Large Water System Regulations Require Well Head Studies which are Likely to Lead to Well Head Protection Plans and Likely to be Restrictive to Some Agricultural Activities. Small Water Systems are Under Review as well. Consultations Are Completed and further Regulations are being Considered.

.16 Municipal WasteWater Treatment Systems At Capacity and Looking at Less Costly Alternatives – Phosphorous Offset Methods.

Housing is on the increase once again across much of the province and is putting increased demands on sewage treatment plants and the assimilative capabilities of receiving waters. Technology is not available or affordable to reduce phosphorous levels further necessitating a search for other methods to deal with the situation.

Phosphorous is the key component. If Phosphorous levels in the river can be reduced i.e. BMP practices by agriculture, present waste treatment technology can still be used (less costly). Another approach that is being looked at is look at the possibility of increasing river flow. Is their waste in the use of water or is too much water being used upstream i.e. Irrigation. These are both major issues for the farm community to face and the pressures will increase as more municipalities face waste treatment expansion and upgrades. Presently, there are four watersheds actively involved in this approach and many more will are forthcoming.

.17 Draught Conditions Have Passed but Discussions on Water Rights and Allocation Will Continue.

Water Response 2000 has been formally adopted as the Ontario Water response plan. This plan outlines the roles and responsibilities of provincial and municipal governments, industry, Conservation Authorities, and the private sector when low water and draught conditions are experienced. Dry conditions in 2001 tested the plan in over 25 locations across the province. Discussions on water Rights and Allocation processes are likely to continue.

.18 Greater Demand for Better Weather Forecasting and Networking for Better Management of Land Application of Manure and Biosolids as Well as for Surface Water Supply Management.

Best management practices for manure application indicate that weather should be taken into account to avoid movement of manure into tile drainage systems and to avoid runoff. For this practice to be effective, better forecasting will be demanded. Managing surface water quantities for flood management as well as draught conditions are equally important and very dependent on accurate forecasting.

.19 Drainage Looked at as Contributor to Low and High Flow Rates in Streams as Well as Water Quality Problems.

In the past, drainage has been accused of increasing peak flows in channels. Now it is also being looked as a contributor to low flows in dry periods. Focus is on base flow reductions and reduced ground water recharge. In addition, tile drains are a pathway for contaminants especially manure from spreading practices. The use of tile drainage is being challenged.

.20 Methane - Greenhouse Gas from manure.

As more and more manure is spread on the land, methane is emitted into the atmosphere which threatens the ozone layer. As people look for more reasons why livestock agriculture should not expand, greenhouse affect could be the next front to deal with. Research is already started in Ottawa.

.21 Vegetable Wash Water Quality and Legislation

Concerns have been raised regarding fruit and vegetable wash water and how it is handled. Applying the legislation as it is in place could have serious economic impacts.

.22 Livestock Access to Streams and Conflict with Fisheries Act

The private sector is searching for new mechanisms to meet their expectations of stream water quality. Complaints have been lodged under the Fisheries Act which is federal jurisdiction and charges have been laid. This is an indication that the public is not satisfied with provincial response to complaints of this nature. Under the Fisheries Act it is much easier to verify a charge.

.23 Irrigation Water Quality and Food Safety

Irrigation water quality and food safety is an issue of the future. Limited situations have been encountered in Ontario i.e. apple cider contamination. It is a rising issue in the US and is likely to be more important here in Ontario especially with fresh produce and quality of irrigation water that is used.

.24 Nutrient Management Bylaw and Plan Court Challenge

Even though nutrient management planning and bylaws are still in their infancy stages in terms of development, the public is not trusting and in their desire for greater environmental security have challenged the nutrient management approach in the courts. Interest is high from both sides of the issue and could greatly influence the future depending on the ruling. Even the impending Nutrient Management legislation has not deterred court challenges, demands for environmental assessments, and more restrictive bylaws.

.25 Impacts of weather to runoff and infiltration.

2001 was another dry year in approximately twenty-five locations in the province. Agriculture, urban water supplies, sewage treatment facilities, private water supplies, recreation, power generation, ecological systems were all affected. Reserves are very low. Problems and conflicts are probable for the coming year unless there is an unexpected turn around in the weather patterns. In some areas, it is projected that it will take 3 to 5 years of normal precipitation to get back to normal. Long-term impacts have not yet been determined.

.26 Farmers having more and more difficult time recognizing how and where to protect the ground water.

Farmers are having difficulty managing operations to meet present day situations related to ground water protection. They need to know the situation on a farm scale to be able to react. No longer can all farms be dealt with in the same way. Situations will be different and management decisions will need to be specific.

.26 Stream management and livestock access still an issue but options are required.

The battle of full access versus no access needs to change. Issues such as where is pasturing and livestock access a better alternative than crop production adjacent to the stream bank. Need to move away from one answer for all approach.

.26 Non-traditional contaminants related to manure will gather additional attention.

As scrutiny of the dangers of manure are put forward, additional items are likely to be added to the list of possible environmental impacts such as hormone and pharmaceutical residues, endocrine disrupters, heavy metals (e.g. copper, molybdenum, zinc etc.)

7.0 REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS

(There are not any responses to report.)

8.0 SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

To Agency(ies)

RECOMMENDATION	AAFC	ARIO	CC	CARC	OMAFRA	OTHER
Priority I (R&D) To develop improved systems for applying manure to no-till, hay, and pasture land and sensitive areas such as ground water recharge zones and shallow topsoil over bedrock areas more accurately, cost effectively and environmentally safe. (R & D) (p.10)	x	x	x 1			
Priority II (R&D) To evaluate and quantify the impact of large livestock operations on the rural environment. (p. 12)	x	x	x 3			MOEE
Priority III (R&D) Investigate and adapt alternative treatment processes to reduce odours from livestock manure and make for a safer product to apply to the land. (p.14)	x	x	x 3			
Priority IV (R&D) To identify sources of microbiological and pathogen related water contamination in agricultural watersheds and put into perspective the various contributors. (p.16)	x	x	x 1			MOEE
Priority V (R&D) To develop a standardized test for manure odour-reducing additives. (Adequately serviced for present) (p.18)	x	x	x 3			

Canada Committees: 1 - Natural Resources 2 - Crops 3 - Animals 4 - Food

9.0 DETAILED RECOMMENDATIONS

Additional Recommendations for 2001 report

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, AND CANADA COMMITTEE ON NATURAL RESOURCES

RESEARCH PRIORITY (New 2001) **(1.1A)**

Investigate methods by which farmers can determine if manure is present in tile water and what benchmark standards are appropriate. **(R & D)**

DETAILS:

This project involves developing techniques by which farmers can determine if manure is reaching tile water and at what levels. The technique must be quick and as simple as possible but attains reasonably accurate measurements.. Standards must be identified and developed to support the testing procedure.

BACKGROUND:

Manure is applied in a short period of time and if manure is reaching the tile water it must be detected quickly or damage will occur before it is found out. Sending samples to a lab is too slow in order to react to a situation. Testing must be done in-situ to be effective. In order to support in-situ testing, standards need to be developed which would indicate if an environmental situation were occurring or about to. The standard does not need to be legislative standard unless one exists but more an indicator standard to afford the farmer an opportunity to react to and avoid environmental incidents. Visual identification of tile water is the primary indicator of manure reaching the water. That technique generally is not considered to be acceptable but is the best method available.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, AND CANADA COMMITTEE ON NATURAL RESOURCES

RESEARCH PRIORITY (New 2001) (1.1B)

Investigate environmental benefits of pasturing floodplain areas and identifying conditions under which the benefit may occur. **(R & D)**

DETAILS:

This project involves investigating the environmental benefits of floodplain alternatives as compared to other land use practices that might occur e.g. row cropping, land tillage etc. Criteria to determine where floodplain pasturing would be appropriate and what other conditions need to be in place.

BACKGROUND:

There is continuous debate regarding cattle access to streams. One side of the issue defending a historical practice of allowing cattle to water from all types of streams and the other side accept only full withdrawal from the stream and full fencing. In many areas of the province, there are floodplains adjacent to stream, rivers and ditches. These floodplains are often difficult to maintain fencing due to flooding and ice. Permanent fencing is impossible to keep in place. Until such time that a flood and ice resistant fence is developed, reality indicates that many of these floodplain areas will be pastured or tilled and cropped. Pastures provide excellent buffer areas. If tilled these areas could contribute significant soil loading to the stream and perhaps destabilize the bank itself. So the question is "are there floodplain conditions" near channels that warrant livestock access to the stream with BMP's implemented as compared to other possible land uses such as row crops, conventional tillage etc. which would result in increased phosphorous loading. These questions need science-based answers.

(Recommendations from 2000)

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE RECOMMENDATION TO AGRICULTURE & AGRI-FOOD CANADA, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, AND CANADA COMMITTEE ON NATURAL RESOURCES

RESEARCH PRIORITY # I (1.1 A)

To develop improved systems for applying manure to no-till, hay, and pasture land and sensitive areas such as ground water recharge zones and shallow topsoil over bedrock areas more accurately, cost effectively and environmentally safe. (R & D)

DETAILS:

Research should be oriented towards developing techniques to accurately apply manure both solid and liquid in a cost effective and environmentally safe manner on known sensitive and high-risk areas. Nutrient management plans are requiring low rates of application and equipment is not available to accomplish the task. Also of great importance is to find techniques of applying liquid manure to tile drained land and without risk of manure reaching the drains through macropores.

BACKGROUND:

As livestock operations get larger, a greater land base is needed. Conservation farming especially no-till is becoming more common. Application of liquid manure to these lands is at risk to movement through macropores to tile drains. The same problem arises when applying manure to hay fields and pasture land. The present Best Management Practice to prevent this problem is to pre-till the land prior to application of liquid manure which is not acceptable. Equipment and techniques need to be developed to overcome this problem. Ground water recharge areas are being studied and mapped. Sensitive areas are being identified for protection and possible land use control. Also, farmers are under much more pressure to complete nutrient management plans but if they need to apply manure at low rates (less than 4000 gal/ac.), equipment is not available to accomplish this task with the accuracy needed.

Some work has been done in this area recently but it was aimed at accurate application of only liquid manure and it involves dropping manure on the surface. There is also a need to address odour reduction and reduction in nutrient losses during spreading through equipment design changes.

COST/BENEFIT:

Society will gain through better management and nutrient application control. The farmers will gain by being able to implement nutrient management plans and save on fertility costs while still protecting the environment.

RESOURCES:

Waste management specialists would be required for the field scale evaluation and design of manure application systems. An agricultural economist should be consulted to determine what economic gains could be achieved.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE
RECOMMENDATION TO
AGRICULTURE & AGRI-FOOD CANADA - EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, CANADA COMMITTEE ON ANIMALS AND MOEE

RESEARCH PRIORITY # II (1.2 A)

To evaluate and quantify the impact of large livestock operations on the rural environment. (R & D)

DETAILS:

A comprehensive study is required to evaluate and quantify the impact on the environment by large livestock operations. Items that must be studied are:

- volumes of water used and possible impacts on ground water supplies
- effects of concentration of livestock facilities in an area versus spot development
- do MDS formulas adequately assess odour potential of large livestock units
- odours from the buildings
- odours from the manure storage
- odours from spreading large volumes of manure
- impact of manure transport on public roads
- ability to handle large quantities of manure and the time required

BACKGROUND:

Increased competitiveness in the global marketplace has encouraged the development of very large, highly efficient livestock facilities. One facility can replace 10-20 old "farmsteads" in both animal numbers and corresponding feed requirements and manure production. Communities and involved government agencies are struggling with developing means to encourage the investment and job placements associated with these facilities while ensuring that environmental issues are adequately addressed.

Concerned neighbouring residents request information and assurances but neither is available. Ontario's experience with impacts of large operations is limited. Large swine operations are the primary target of late. This trend is likely to spread to other livestock types in the future.

Also, the water needs of these large operations are such that there may be an impact on neighbouring water user's supplies. Answers should be obtained before water supplies are stressed or depleted.

COST/BENEFIT:

Proper guidelines and possibly rules need to be developed so that communities can feel confident that environmental issues are properly addressed. Ideally, the guidelines or rules should be similar across all communities so that location of facilities can be based on other issues rather than individual community environmental acceptance. Decisions if made now would be based on subjective rather than objective information.

RESOURCES:

This project spans many fields of expertise from waste management specialists to hydrogeologist to rural community advisors.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE
RECOMMENDATION TO
AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, AND CANADA COMMITTEE ON ANIMALS

RESEARCH PRIORITY # III (1.3 B)

Investigate and adapt alternative treatment processes to reduce odours from livestock manure and make for a safer product to apply to the land.
(R & D)

DETAILS:

This project involves an examination of various manure treatment options with the specific goal of reducing odour levels at the barn and storage and to make the manure safer to land apply. It is especially aimed at liquid swine manure systems, though the suitability for other livestock types should also be considered. Treatment could occur during collection, during transfer to storage, during storage, or some combination. The feasibility of biofilters, mechanical systems, aeration, bacterial and enzyme methods etc. needs to be investigated. There are two phases of odour generation to investigate i) from the barn and ii) from the storage. Some of these technologies have been successfully applied to urban and industrial applications. There needs to be a concerted effort to apply these technologies to treatment of livestock manure.

BACKGROUND:

Livestock manure, like any other biological material, undergoes a breakdown of organic matter by microorganisms. When this happens in anaerobic conditions, such as with traditional liquid manure systems, it results in odours. Proper separation distances to conflicting land uses, good housekeeping practices, and covers on storages are examples of methods farmers have used to reduce odour impacts. These approaches are not enough to satisfy the present day rural population. Manure treatment research has been going on for many years but the focus has not always been odour control - other factors have included: reducing volume, concentrating or changing the form of nutrients, producing methane, etc.
Research is needed to examine methods of odour control practical for use on today's farms, especially targeted at large swine farms with liquid manure.

Composting of liquid manure is one technology that is being investigated and should continue. Others include biological treatment, chemical treatment, methane digestion, use of additives, mechanical aeration, separation in combination with a further treatment step, dehydration, and hers.

COST/BENEFIT:

This research will be of greatest benefit to large operations using liquid manure, especially swine. The viability of the industry hinges on being able to expand and build these specialized units. Better solutions are required than bylaw control, which will greatly hinder the competitiveness of the industry.

RESOURCES:

This project needs the cooperation of researchers in waste management, odour control, and economics, as well as livestock specialists, agricultural systems specialists, and livestock farmers. Lab and Farm-scale projects will be needed.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO
AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, CANADA COMMITTEE ON NATURAL RESOURCES, and MOEE

RESEARCH PRIORITY # IV (1.4 B)

To identify sources of microbiological and pathogen related water contamination in agricultural watersheds and put into perspective the various contributors. (R & D)

DETAILS:

A comprehensive study is needed to examine all sources of microbiological and pathogen water contamination in agricultural watersheds and put into perspective the relative contributions of the various sources. There should be equal focus on surface and ground water quality. Key indicators would include: E. Coli bacteria, Cryptosporidium, giardia, and other related issues such as hormones, heavy metals, and antibiotics. Practices to consider would include:

a) farm practices such as: tillage, nutrient management, manure storage and spreading, livestock pasturing, crop rotation; and
b) non-farm practices such as road construction and maintenance, rural septic system use, municipal sewage treatment plant scheduled and unscheduled releases, other spills, wildlife, etc.

BACKGROUND:

Research effort in the past has been directed at individual farm practises (such as manure spreading) and examining water quality impacts, then recommending changes in farm practices to reduce the potential for water quality impairment. A considerable amount is known about the water quality impacts of many of these individual farm practices. What is not well understood is the big picture - what the relative contributions are of many activities in a watershed to the overall water quality of the watershed.

In these times of limited financial resources to solve environmental problems we need to be able to target the practices that are having the greatest impact. For example, if the sediment loading in a watershed is unacceptable and if the greatest loadings are caused by poor practices of ditch construction and repair, we should not direct all our efforts toward further reducing soil erosion. Similarly, if the bacteria loadings are found to be split between animal and human sources, we should direct more effort (compared to current levels) into identifying the pathways and preventing the human contributions.

Ultimately, the most useful result of this research would be a comprehensive computer program that would consider many factors and could be used to model loadings and identify most likely sources of contamination and most cost effective education/prevention efforts. Models are in the process of being developed or adopted to the situation and the effort should be further supported.

COST/BENEFIT:

As individual farms grow in size, it is likely that more and more of the blame for reduced water quality will be directed to farmers, whether warranted or not. Municipal controls will become stricter, especially on livestock farming. Being able to avoid some of the speculation on contamination sources and address the real problems may help avoid laws based on more emotion than fact. This could have a profound impact on whether a farm operation can even establish or expand in a given municipality.

RURAL ENVIRONMENT ENGINEERING SUBCOMMITTEE

RECOMMENDATION TO

AGRICULTURE & AGRI-FOOD CANADA-EASTERN REGION, AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO, AND CANADA COMMITTEE ON ANIMALS

RESEARCH PRIORITY # V (1.5 C)

To develop a standardized test for manure odour-reducing additives. (R & D)
(This recommendation is somewhat being serviced by facilities in the U. S. and Quebec)

DETAILS:

This project involves an examination of what evaluation procedures are in place and develops a standardized test procedure to evaluate the effectiveness of these additives. Testing must be "realistic". First level testing may be in small vessels in lab for initial screening process but must also include field scale testing in larger tanks outside where manure is added on a continuing basis through variable seasonal conditions.

BACKGROUND:

Many additives are now on the market-some are enzymes, some are masking agents, some change the pH, some are bacterial in nature, some may be feed additives, and affect digestion, etc. Some work has been initiated in the US by Bundy, some in Montreal by Suzelle Barrington, and some is currently underway by the Prairie Swine Centre. Odours are still identified as the main reason for the resistance to large livestock operations. There is a need to advance the techniques and coordinate the test procedures with other researchers so all products are evaluated in a similar manner. Testimonials are not acceptable.

COST/BENEFIT:

This research will be of to all livestock operations but especially to large the swine operations using liquid manure. In some cases, whether these farms can effectively control odours may determine their ability to expand or establish a new facility in an area as bylaws become more and more restrictive.

RESOURCES:

This project needs the cooperation of researchers in waste management, odour control, and economics, as well as livestock specialists, agricultural systems specialists, and livestock farmers. Farm-scale projects will be needed though lab-scale projects may be appropriate for initial evaluation of manure additives.

10.0 APPENDIX

.1 Terms of Reference

1) To review research work and service programs being carried out in Ontario and elsewhere.

2) To disclose problems that face the agricultural industry and which require investigation.

3) To assess and suggest priorities for new research, development, service and information transfer programs and recommend which programs presently under way should be continued, expanded or terminated.

4) To make recommendations on:

    a) Planning and conducting co-operative research, development, service and information transfer projects, and

    b) Dividing and allocating research projects in order to provide co-ordination and to avoid unnecessary duplication between stations.

5) To estimate, where possible, costs involved in the conduct of new programs and to supply cost/benefit information.

6) To recommend, where possible, how monies might be obtained or freed to expand current programs or conduct new programs.

7) To supply a written report, at least annually, to the Agriculture and Food Engineering Research and Services Committee.

8) To participate in the planning and execution of meetings: to share research, development, service and information progress and to determine problem areas that need to be addressed.

11.0 Rural Environment Engineering Subcommittee Membership 2001

Jim Myslik, (Chairman) 519-846-0941 519-846-8178(Fax)	Agriculture & Rural Division, OMAFRA, Wellington Place, R. R. # 1, Fergus, Ontario, N1M 2W3
Hugh Whiteley 519-824-4120 519-836-0227(Fax)	School of Engineering, University of Guelph, Guelph, Ontario, N1G 2W1.
Robert Stone 613-475-1630 613-475-3835(Fax)	Agriculture & Rural Division, OMAFRA, Box 8200, Brighton, Ontario, K0K 1H0.
Sid Van der Veen 519-826-3552 519-826-3259(Fax)	Resources and Planning, Branch, OMAFRA, Box 1030, Guelph Agricultural Centre, Guelph, Ontario, N1H 6N1.
Ross Irwin or designate 519-822-3993	Delegate, Land Improvement Contractors of Ontario, 24 Marilyn Dr., Guelph, Ontario, N1H 8E9
Mike McMorris (519) 824-0334 (519) 824-9101 (Fax)	Ontario Cattlemen's Association 130 Malcolm Road Guelph, Ontario, N1K 1B1
Ron Fleming 519-674-1612 519-674-1600(Fax)	University of Guelph - Ridgetown College, Ridgetown, Ontario, N0P 2C0
Sam Bradshaw 416-621-1874(212) 416-621-8720(Fax)	OPPMB, P.O. Box 740, 15 Waulron St., Etobicoke, Ontario, M9C 5H3
Tracy Ryan 519-621-2761(269) 519-621-4844(Fax)	Grand River Conservation Authority, 400 Clyde Rd., Box729, Cambridge, Ont., N1R 5W6

.3 Inventory of Person Years

.4 Coding System

A four part code is used to identify each of the projects outlined herein.

The first part, the roman numeral, identifies the subsection of agricultural engineering to which the project belongs. These subsections are:

I	Energy, Power and Processing
II	Power and Machinery
III	Rural Environment
IV	Structures and Environment

The second part identifies the priority of research:

1. Very Important
2. Important
3. Desirable

The third is a coding number. It indicates a listing order but not necessarily the project's priority within the group.

The fourth is a letter to indicate the level of research in that topic:

A - New topic, no known research.
B - Expansion needed, some research under way.
C - Continue at existing level.
D. - Research complete, reallocate efforts to A or B.